JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

FEBRUARY, 1851.

CIVIL ENGINEERING.

Improvements of the River Seine. *By* GEO. R. BURNELL.*

Some very important works are in progress at present upon the river Seine, for the improvement of the navigation of that river, a succinct account of which is appended.

The Seine has a very long devious course, principally through a valley in the tertiary limestones of the Paris basin, and through the chalk between Mantes and the sea. It is very subject to floods in the winter and spring, which come down from the hills of Burgundy with considerable violence; whilst in the summer it is often so low that, as in 1842, the navigation by barges drawing 4 feet water is suspended. The tide runs to a little beyond Pont de l'Arche, a distance of perhaps 60 miles.

Owing to the configuration of the embouchure a bar is formed at Quillebœuf and Tancarville, at a point where the river—which had previously spread out on both sides over a flat alluvial plain, sometimes bare at high tides—is contracted between two advancing spurs of the chalk formation. Formerly the regime thus superinduced was such as to give rise to a "bore" of about 3 to 4 feet high occasionally; but at neap tides there was never enough water on the bar to allow a 400 tons' burden ship to mount the river, although directly the stream became narrowed above Villequier, sufficient depth to float even a 1000 ton ship existed at high tides.

The objects proposed then were to deepen the river so as to allow large vessels to reach Rouen, and to establish such a system of locks, &c., in the upper portion, as to ensure a constant depth of 6 ft. 6 in. in the driest

* From the London Architect, September, 1850.

seasons as far as Paris. The works already executed have succeeded most remarkably in the attainment of these objects as far as they bore upon them. They are as follows:—

Tidal Portion.—Up to August, 1850, they had been confined to the embankment of the river between Candebec to Villequier and Quillebœuf, by means of rubble-stone embankments of length of 18,000 metres on the right bank, and of 9600 on the left bank. At the point where the works commenced the channel was made 300 metres (1000 feet) wide; and it was augmented 10 metres in a kilometre, or in the ratio 1 : 100 to the embouchure. The concave embankment was found to require twice as much stone as that upon the convex side, the former taking 100 metres cube, the latter 50 metres cube, per metre forward.

The result has been to deepen the river 2·80 metres (a little more than 9 feet). The "bore" has disappeared in the parts regularised; the length of the duration of the flood tide increased one hour; the still water, or dead tide, has also gained a quarter of an hour. The flood would be sent much further up the country did not the stone thrown to protect the feet of the piers of the Manoir Bridge, on the Rouen and Paris Railway, act as a dam to keep it back. It is probable that the result of the works in the river upon this bridge will be to throw it down.

The total cost of the embankments has been hitherto 2,310,000 francs, or 92,400*l.* sterling, being at the rate of 3 francs the metre cube of stone in place.

To complete the project, it would be necessary to execute above Candebec and la Meilleraie 5122 metres of embankment on the right, and 8700 upon the left shore. Below Quillebœuf it is proposed to continue the channel through the sandbanks of the embouchure, by the execution of 12,540 metres on the right bank, and 9600 upon the left.

Natural Water Course above Tides.—The system adopted for the attainment of the depth required in this portion, has been to erect a series of barrages or weirs upon the river, so as to divert the water into the arm rendered navigable, and to leave an overflow under the control of the locksman at the head of the pond or reach.

The weirs are formed according to the plan so successfully applied by M. Poirée at Bezons, consisting of a series of wrought iron frames with wooden blades to close the openings, fixed by hand; the wing walls are in stone, and dressed off at a level to allow any flood-water to overflow at 6 inches above the depth required in the lock, should any sudden flood come down by night. The locks are made 120 metres long by 12 metres wide (400 feet by 40 feet), and a fall of 2 metres, or 6 ft. 7 in. nearly.

Originally it was proposed to form at least ten of these barrages. The first is formed in Paris itself, and is actually in course of execution; the river is being inclosed to a width of 32 metres in the narrowest part, beginning from the extremity of the Isle de la Cité, and terminating at the extremity of "terre Plein" of the Pont Neuf. The wing walls of the dam are dressed off at a height to secure 2·16 metres water; the barrage is meant to heap them up to 2·26 metres; but of course before arriving at this height, some of the blades would be drawn. Quay walls and roads, with inclined approaches from the upper level, are being formed; a large culvert, 2·50 metres wide by 2·50 metres from invert to key, is also constructed

to take off the lateral sewers to a level below the locks. These works are estimated to cost 200,000*l.* sterling.

Connected with these works may be cited the lowering of the roadway of the Pont Neuf, to cost 72,000*l.* The old arches are cut away where necessary, and replaced by new arches of an elliptical form, the space between the new and old work, where any exists, being filled-in with hydraulic lime concrete. The scaffolding employed is very remarkable, being in fact a suspension scaffolding, hanging from the turrets on the piers of the bridge. Indeed, it would be impossible to imagine how works could be so carefully, so perfectly, and so elaborately executed, as all these are, unless by French engineers, working with government money.

Other barrages have been executed at Bezons, Andresy, and Vernon; one at les Poses, near Pont de l'Arche, is in course of execution. Barrages are to be formed immediately at St. Ouen Meulan; others are proposed at Suresnes, Maisons, Triel, and perhaps others below Meulan.

The barrage executed at Bezons, at a cost of 70,000*l.*, gave a sur-elevation of 120 metres (4 feet) at a distance of 7½ miles from the locks, the fall of the river being on the average 0·10 per kilometre, or 1 in 10·000. The heaping-up of the waters by the barrage of Andrésy is felt in the Seine and Oise, at a distance of 20 kilometres, or 12½ miles.

At some future day I will send you drawings of the barrage of Bezons, which will illustrate the very simple, but efficient means employed on this river, to canalise it completely.

Southampton, Oct. 23, 1850.

---

*Ventilation.**

Sir John Walsham has devised a very simple plan for ventilating workhouses, and which has been most effectual in the several unions where it has been introduced, and would, no doubt, be equally available for hospitals, factories, or workhouses. It consists of zinc tubes, three inches in diameter, perforated at the sides, towards the bottom, with holes of $\frac{1}{12}$th of an inch diameter, which are carried across the ceiling of the room, suspended by hooks, and taken through the walls to the open air, where they terminate in perforated convex ends, provided with caps, hung by a small chain, to cover the end most exposed to the wind in extremely cold weather. Three tubes will suffice for a room 23 feet by 16, or in that proportion for large apartments, intervals of about 10 feet in the length of the room being ordinarily the just medium. They can be fixed at 5*d.* per foot run. Mr. Bridgham, master of the Loddon union-house, describes them as most beneficial, particularly in the sleeping rooms. "The inmates are much pleased with them—many were fearful they would take cold from them; they are now satisfied that there is not any draft occasioned in the room by them." In the Bishop Stortford union, "in a sick ward, with cases of a loathsome and offensive kind, tainting the air to such an almost incredible extent that few gentlemen of the committee would go into it, the effect was so good, that the guardians gave an order to ventilate the whole house."

* From the London Architect, for November, 1850.

*Construction of the Roof of the Great Exhibition Building.**

In our last number we made some remarks in reference to the ultimate stability of the building, which have, we are glad to learn, been carefully weighed by the authorities, and are likely to meet with attention. Indeed, it is only by careful consideration in the beginning that eventual evils can be successfully precluded, and satisfactory grounds be laid for public confidence in a new and untried undertaking, in the prosecution of which to completion the national reputation is now at stake. We must neither leave off in our progress, nor must we carry it on to subject ourselves to discomfiture.

In the following semi-official communication in the *Times* we do not wholly concur; but it contains many points of interest, and shows that the authorities are disposed to make alterations where they may appear requisite:—

"There not only was greater care requisite in order to give rigidity to the central and most trying point of an edifice where safety and strength are so imperatively necessary, but the task of construction presented greater novelty of detail and less sameness of combination, as will be easily understood from the plan. In the first place, with reference to strength and stiffness, the whole structure was, in the opinion of experienced architects—men well qualified to pronounce an opinion—deficient in what is technically termed 'diagonal bracing'—a principle of construction introduced by Sir Robert Seppings into the building of our larger ships, and the importance of which to an edifice like 'The Crystal Palace' will be readily conceived. This mechanical appliance had not been included in the plan, because it was believed to be unnecessary, and likely to prove cumbersome. Messrs. Fox & Henderson, the contractors, still express a confident opinion to that effect, and adduce proofs drawn from slight accidents that have occurred in the course of the works in support of their views. Their most experienced hands also declare that at the top of the third tier there is at present less vibration than at the top of most houses in the metropolis. Notwithstanding all this, however, the building committee have determined that, in the centre at the points of junction of the transept and principal aisles, and also at the extremities and other parts of the building where any strain is likely to be unduly felt, 'diagonal bracing' shall be introduced. We are strongly inclined to think that in this they have exercised a wise precaution. It is no doubt true that the lightness of construction contemplated by the design of Mr. Paxton may be apt to excite apprehensions of insecurity which are unfounded; but where the slightest doubts are entertained by persons well competent to form an opinion, it is obviously best to err on the safe side."

We have never faltered in our opinion of the ingenuity displayed by Mr. Paxton and his colleagues in the design and in the execution, and we are strongly of opinion that the Exhibition Building will exercise a material influence in extending the range of architectural exertion, and in improving the practice of construction. There is scarcely a part of the building in which some new mode of construction has not been adopted:

* From the London Architect, for November, 1850.

some new application of mechanical skill, or some economical arrangement been brought to bear. Some things have yet to be tested by experience, but some are patent and decided results, from which example may be already taken. Thus the building has peculiar interest to practical men, and we are glad of every opportunity of giving information with regard to it.

The portion we are now able to illustrate is the structure of the roof; and we shall, as far as possible, conform to Mr. Paxton's own description given at the Society of Arts last week. This subject is of the more interest, as Mr. Paxton has for many years made it his particular study, and he has peculiar opportunities of investigating the construction of light roofs.

In 1828, the various forcing houses at Chatsworth were formed of coarse thick glass and heavy woodwork, which rendered the roofs dark and gloomy. His first object was to remove this evil, by lightening the rafters and sashbars, which was done by beveling off their sides. He also contrived a light sashbar having a groove for the reception of the glass; this groove prevented the displacement of the putty by the sun, frost and rain. In horticultural structures, such as Mr. Paxton was engaged in, it is of particular importance that the light and heat of the sun should not be obstructed; it was therefore his object to get, as far as possible, a glass roof, and thereby a light roof.

Most of the rays of light and heat were obstructed by the position of the glass and heavy rafters. This led him to the adoption of the ridge-and-furrow principle, which places the glass in such a position that the rays of light in the mornings and evenings enter the house without obstruction. In 1834 he made a further experiment on the ridge-and-furrow principle, in the construction of a greenhouse of considerable dimensions, adopting a still lighter sashbar than any previously used; on which account the house (although possessing all the advantages of wood) was as light as if constructed of metal.

In 1837, in constructing the great conservatory at Chatsworth, it was found desirable to contrive some means for abridging the manual labor required in making the immense number of sashbars requisite. The only apparatus met with was a grooving machine, which was subsequently so improved as to make the sashbar complete. For this apparatus the Society of Arts awarded Mr. Paxton a medal; and this machine is said to be the type from which all the sashbar machines now used are taken. The machine saved in expense £1400. The length of each of the bars made by it is 48 inches, only one inch shorter than those of the Exhibition Building; therefore there was adequate experience as to the working of the sashbar machinery for the Exhibition Building.

The roof of the Exhibition Building is built on the ridge-and-furrow principle, and glazed with English sheet glass, the rafters being continued in uninterrupted lines the whole length of the building. The transept portion, although covered by a semicircular roof, is likewise on the angular principle. All the roof and upright sashes being made by machinery, are put together and glazed with great rapidity, for, being fitted and finished before they are brought to the place, little more is required than to fix the finished materials in the positions intended for them. The

length of sashbar is stated by Mr. Paxton at 205 miles. The quantity of glass is about 900,000 feet, weighing 400 tons.

On each of the longitudinal wrought iron framed girders is laid a gutter, and upon and communicating with this, four transverse gutters and plates, on which are laid the sash-bars of the four ridge-and-furrow roofs and glazing. The water falling on the glass is carried to the transverse gutters in the furrows, thence to the longitudinal gutters on the girders, and so down the hollow columns of the building to the bases, whence it is carried off by 6-inch cast iron water pipes.

The glass made use of is English crown, 50 inches long, 10 inches wide, and $\frac{1}{16}$ inch thick, running from the ridge-piece to the gutter-plate. The object of this length is to do away with overlaps.

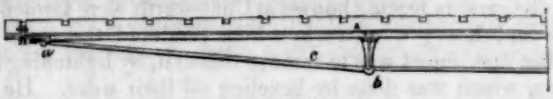


Fig 1.

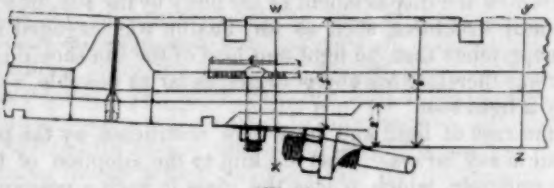
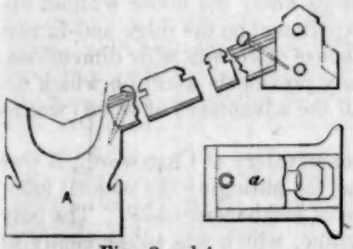


Fig 2.



Figs. 3 and 4.

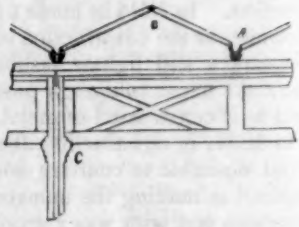


Fig. 6.

The transverse trussed gutter-plates or troughs are cut out of solid fir scantling by machinery before they are brought on to the building. These transverse gutter-plates are trussed with wrought iron rods, bent in the form shown, which can be screwed up or slackened by nuts at the end.

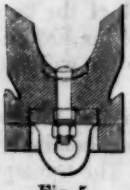


Fig. 5.

Having explained the general construction, we shall now refer to our engravings. Fig. 1 is half-length of the transverse gutter-plate A, the whole length being 24 feet, width 5 inches, and depth 6 inches. On the lower part of the gutter-plate is seen the tension rod *c*, 1 inch in diameter, secured by a nut and screw-plate at *a*, and passing through the eye of the queen bolts *b*. It is particularly worthy of observation that the gutter-plates are made with a camber, so that the rain-water shall fall from the middle of the gutter to the ends, be readily car-

ried off, and be precluded from lodging. The but-ends of the gutter-plates, as shown in fig. 2, are likewise brought together, and fixed in a cast iron shoe, with an aperture to carry the water down into a square trough.

Figs. 2, 3, 4, and 5, are enlarged views of the gutter-plate, drawn to a scale of one-fourth the full size. Fig. 2 is a side view, showing the ends of the tension rods with the nut and screw, and cast iron plate fixed to the underside of the gutter-plate, of which fig. 4 is a view of the underside, and fig. 5 a transverse section of the gutter, showing the end of the tension rod, and how the plate is fastened to the timber.

Fig. 3 is another transverse section of the gutter at *y z*, and also of the skylight, showing the wooden bar of the skylight and the ridge. The ridge is worked by machinery out of solid deal 3 in. square, and the butting joints have ½-inch dowel 3 inches long. The ordinary skylight-bars are 1½ inches deep by 1 inch wide, shown in the small section, with a ¼-inch groove on each side to receive the glass. The other small section shows the form of other intermediate skylight-bars called string-bars, which are 2½ inches wide by 1½ inches deep. It will be perceived by the section, that the skylight-bars frame into the ridge, and are notched on to the trough gutter, being secured at top and bottom by 3-inch nails. For the purpose of taking off any condensation forming within the building which may run down the glass, a groove is provided worked on each side of the gutters.

The skylights are 8 feet span, and have an incline of 2½ to 1.

Fig. 6 is a transverse view of one of the ridge-and-furrow skylights.

Fig. 7 is an elevation of the exterior, showing the two stories, the lower being closed with boarding, and the upper glazed. The base, to the height of 4 feet, is fitted with luffer boarding, with the view to ventilation.

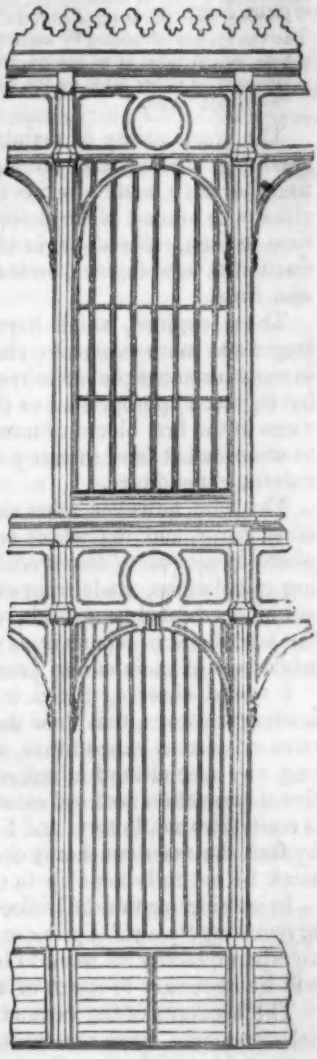


Fig 7.

If the several details be carefully examined, it will be discovered there are several contrivances to save labor and facilitate fixing. It will be interesting to observe that, in matters so common and so common-place, there was yet room for the exercise of research and ingenuity.

Remarks upon the Cost of Repairs of Locomotive Engines. (*Written January*, 1849.)*

Made with a view of showing the financial advantage gained to a Railway Company, by keeping its whole stock of engines in a full state of efficiency in perpetuity, in preference to the system advocated by some parties of considering 10 years, or a somewhat longer time, as the "life" of an engine, and that a greater or less number of new ones must of necessity be either made by the Company, or purchased at different periods, to replace "worn out" ones.

The practicability of maintaining an engine at her full effective value, cannot be denied, and although experience might be supposed, by this time, to have made obvious the actual cost of so doing, yet the original old stocks of most of the Railway Companies, have been frequently, from time to time, *relieved*, or, in other words, *indirectly repaired*, by the introduction of new engines, built nominally for the traffic of *branch and extension lines*.

These engines, which have been, for the most part, of a very much larger and more expensive class than the traffic of branch lines has been in most instances proved to require, have been paid for out of *capital*, and having been appropriated to the purposes of all general traffic, their services in the first bloom of newness and efficiency, have of necessity gone to some extent (and in many cases greatly so) to relieve or diminish the current expenditure.

The time, however, must shortly arrive, when these additions to stock must cease, and the whole requisite stock be either *maintained* or *replaced by new out of the current earnings* of the Companies, and the following calculations, made from experience in working engines, without the aid of occasional new stock, will tend to render more perspicuous what the actual cost of repairs *must* ultimately be, and will show the pecuniary advantage of *maintaining* over renewing stock.

I would observe, that it is asserted by the executive of some of the leading railways, that their stocks *are* fully maintained, at their present rates of current expenditure, and that there is no necessity for appropriating any special fund in reserve for depreciating or renewing. I admit that depreciation *need not* exist, and I contend that it *ought not*, but, that it really *does not*, I DENY, and I defy any Railway Company to substantiate, by fact, the assertion that it does not. [That is, our author means if the stock be not fully kept up in timely repairs.—ED. *R. J.*]

In considering the difference of cost between maintaining and replacing or renewing "plant," I propose to speak of engines individually, assuming a certain quantity of work to be performed. Of general depreciation, it will be necessary to speak of the stock more collectively.

The accounts of the various Railway Companies, and occasional published remarks, have represented the current cost of repairs, per engine, at from 2d. to 3d. per mile run, and superintendents have vied with each other in the smallness of their amount of expenditure on this head. The one who worked at 2d. of course priding himself greatly on his superiority over his neighbor of 3d. Not being aware of their respective systems of calculating mileage, I am inclined to believe that the charge of 3d. is

* From the London Railway Journal, for November, 1850.

made on a much more honest amount of work done, and that such a charge would at any time show a stock *more like what it ought to be* than the other.

I consider the only fair and proper method of charging expenses to be on the number of miles *in actual service drawing trains*, whether of loaded or empty vehicles. Necessity will frequently require that engines be sent out on trips, or run "return trips" empty or without a load, but these distances have no right to be placed to their credit of mileage account in repairs. A good engine should never be within giving a few occasional miles empty.

I propose to show calculations made upon an extreme, and also upon a more moderate amount of work done. Premising, however, that they have been based upon the assumption that the different amounts be *fairly* and *judiciously* expended. *Books* will show an amount of *expenditure of money*, but the *condition of the stock* can alone show whether *talent* and *prudence* have been exercised in *the appropriation of it*, and on this account I submit, that it is the bounden duty of every board of Directors, to have an annual valuation, if not of all their floating locomotive stock, at least of each engine specifically; and, furthermore, I contend that the character of locomotive superintendents generally, is somewhat compromised by their *not insisting on such valuation being made.*

Let us suppose, then, that an engine of the best manufacture, say £2500, was newly set to work on the 1st of January, 1849, and that *either* the same engine must stand ready for work newly repaired, and in no single respect inferior in effective value on the 1st of January, 1859; or that she be worked to an extremity during the coming ten years; sold at the end of that time for what she would fetch, and a new one precisely similar, stand ready to take her place. I will first comment upon the latter supposition, viz., that it be the intention of her owners to replace her with a new one in ten years, and consequently to get as much work out of her as possible during that period, at the lowest possible current cost.*

Assuming, then, that by extraordinary good luck she runs 300,000 *miles* in the ten years, as follows—140 miles per day, five days every week, or in round numbers 3000 per month, for the first twenty months up to the 31st of August, 1850. This would give a total of 60,000 miles every two years, allowing the last four months to refit her for commencing work again.† And in addition to this we have an allowance of two days every fortnight for overhauling and casualties.‡

Upon the above distance, viz., 300,000 miles§, let us suppose 2d. per

* 2d. per mile named in my prefatory remarks, is, I believe, the lowest quotation for repairs that has yet been exhibited.

† Taking into consideration the various sources of interruption which occur to retard *thorough repairs*, four months would be found not too much time to make her fit to resume her station.

‡ She may either rest one day a week, two days together every fortnight, or four days a month, as convenient, but an average of one day a week will not be found too much *in the aggregate.*

§ Having proposed to show calculations on an extreme, and also on a more moderate distance run, I have adopted 300,000 miles as an extreme. I don't believe any engine ever did run that distance in ten years. I don't deny the possibility of its being done, but it would require a special qualification, and would absorb more time and care than could be devoted *practically* to any *one engine.* I have assumed it in order to give every advantage to the low figure of 2d. per mile for repairs.

mile appropriated to repairs. Now, in repairs there are two specific items of the most expensive nature, which cannot be set aside, viz. *fire-boxes and tubes*,* as upon the perfect state of these depends the entire well-doing of the engine, or nearly so. I will, therefore, first make a specific charge for these.

I consider that with the above named hard work an engine would require, at least, a new set of tubes every two years, or 60,000 miles,† and a new fire-box, say at the end of every four years.‡ We have, therefore, to debit our engine with the cost of two new fire-boxes in the ten years, and four sets of new tubes, viz. a set at the end of the *second*, *fourth*, *sixth*, and *eighth* years, the last set of which would keep her going till the end of the tenth year, when we have assumed she would be sold. The account will then stand thus:—

2d. per mile upon 300,000 miles, ...			£ 2500
Deduct 4 sets of tubes, ...	£ 1200 §		
" 2 new fire-boxes, ...	360		
	£ 1560		
Less by credit of old tubes, . .	£ 280 ‖		
" " of fire-boxes, . . .	180		
	460		
		1100	
		£ 1400	

Thus showing a clear demand of 44 per cent. on the amount allowed for *repairs* of *engine* and *tender* for ten years, and leaving a balance of only £1400 for general purposes. A moment's consideration of the costliness of many other specific items, viz., wheels and axles of both engine and tender, cylinders, pistons, &c., besides the innumerable smaller matters which are involved in a thorough repair, to say nothing of a due share of general charges,¶ will render the utter inadequacy of the above sum too palpable to require any comment.**

I will, therefore, (still giving her credit for doing the above extreme amount of work, say 300,000 miles,) assume that 2½d. per mile be allowed for repairs during ten years; that she have a thorough repair every two years for eight years, and at the end of ten years she is to be offered for sale.††

* Whatever other repairs may be neglected or delayed, these two *must* be kept up. The loss of power from a defective boiler is incalculable.

† Few tubes do run this distance even with the best of coke.

‡ A new tube plate is sometimes introduced as a temporary relief to fire-boxes, but considering the expense of taking out and putting in, I think it the best economy to renew the whole box, as we have the old metal to our credit, and a really good job cannot be made of staying the sides of an old box the second time.

§ Tubes are taken at the set of 200 in number, 11 feet 6 inches long, and 2 inches outside diameter. These will cost at least 28s. per tube, delivered at the Company's works, and I allow £ 20 per set for ferrules and putting in. New fire-boxes are assumed at 26 cwt. of copper, at 11d. per lb., and allows about £ 45 for making and putting in.

‖ Old tubes are taken at one-fourth their original value, viz., half-price, less diminution of weight of 33 per cent. or more, and the expense of taking out and back carriage. Old fire-boxes allowed half their original cost.

¶ General indoor charges include stationary engine for driving machinery, repairs to machinery, tools, and buildings; rates, superintendence, foremen and clerks, gas, &c.

** It is evident that, even if kept alive at all, she would work at a great sacrifice of power, &c., and be utterly unsaleable at last.

†† Be it remembered that being now, as it were, "used up," any purchaser would be necessitated to lay out an extravagant sum to make her available.

The account in this case will stand as follows:—

2½d. per mile upon 300,000 miles, . . .	£ 3125
Dr. to fire-boxes and tubes, as before, . . .	1100
	£ 2025

Now, supposing that she actually runs twenty months at a time, and at the end of each period has a thorough repair, it will be necessary in the division of the above sum of £2025, to vote £100 or thereabouts, to be expended *during* each period of running for *casualties*.*

Taking a low allowance, let us say for the ten years 425*l.* This leaves a balance of 1600*l.* to be divided into four thorough repairs of *engine and tender*, and at the end of the last two years she is to be unhooked from her last load, drop her fire, and be offered for sale. If a purchaser be found at all, she might probably fetch 400*l.*, certainly not more,† and I appeal to any man experienced in such things, whether, after her great amount of work done and limited allowance for repairs, the above sum be not a handsome one.

Assuming this to be the result of ten years' work at an allowance of 2½d. per mile for repairs, our account will stand thus:—

By sale of old engine, ...	£ 400
Reserve required of 1½d. per mile *beyond current expenditure* on 300,000 miles, ...	1875
Assumed bank interest on accumulating reserve fund at 2½ per cent.‡	225
	£ 2500

Required to pay for the new engine which is to succeed the old one on the 1st January, 1859.

We therefore see that, under the most favorable circumstances, a sum of 4d. *per mile* run must one way or other be appropriated, if old engines are to be periodically replaced by new ones,§ or a gross cost of 5000*l.*, taking advantage of interest on accumulating money.

It being evident, therefore, that, with an extreme amount of mileage, a current charge must inevitably be made on revenue of at least 4d. per mile run, if the renewing system be adopted, let us see the demand on our revenue under the circumstances, supposing it were our intention to *maintain the same engine*, and have her fully repaired and ready to

* These casualties are the ordinary small jobs which each working engine requires, and *must have done*, and for which the average time of one day per week is allowed. I have taken no account of *serious accidents*, which the whole world knows are often very expensive, and which must continue to occur occasionally to the end of time. I consider that the expenses of a serious accident to any one engine should be put to the account of "general charges," and be proportionately borne *by all*. All are liable to accident, and all should help to relieve.

† I say this from having had some experience in the sale of worn out engines, and it is not unlikely she might have to wait many months before such a sum, or even a less sum, could be got for her.

‡ I fear few Companies would be found to have been so prudent as to take advantage of this interest on accumulating money.

§ Not having to devote the last four months of the ten years to repairs, it may be argued that an extra quantity of work might be obtained from the engine in the given time. I maintain that her condition would be such that she would barely complete the 60,000 miles in the last two years, including the extra time. If she realized any excess, it might be placed to the relief of bank interest, for if the amount allowed for this were not realized, it would require an extra charge of nearly ¼d. per mile on 300,000 miles to make up the difference.

commence *a second ten years work on the first of January*, 1859. The specific repairs of fire-box and tubes will in this case bear a different proportion, and instead of two fire-boxes and four sets of tubes, I must here charge the engine with two and a half fire-boxes and five sets of new tubes,* making, after allowance for old metal, a demand of 1375*l.* for these two items alone. In addition to this I will allow a clear charge of 100*l.* for each period of twenty months' running, to be expended in casualties, or a gross charge for ten years of 500*l.*,† and instead of four thorough repairs at 400*l.* each, I will give 2500*l.* to be divided into five thorough repairs, (the last, of course, being done between the 1st September, 1858, and 1st January, 1859,) say four repairs at 450*l.* each. At the end of the *second*, *fourth*, *sixth*, and *eighth* years respectively, and a clear 700*l.* to cover all at last,‡ exclusive, of course, of fire-boxes and tubes charged before.

This shows our account to result as follows:—

Fire-boxes and tubes, ...	£ 1375
£ 100 every twenty months for casualties, . .	500
Four thorough repairs at £ 450 each, . .	1800
One final do. at £ 700, ...	700
Total, ...	£ 4375

Or a gross cost of 4375*l.* on 300,000 miles, averaging a charge of under 3½d. per mile, being ½d. per mile less than in the case of buying a new engine.

This difference of ½d. per mile on 300,000 miles makes a gain of 625*l.* per engine to the Company every ten years.§

To be Continued.

A Flue of Flues.‖

In course of operations in the Tamar Silver Lead Mines, on the borders of Devon and Cornwall, it became latterly essential either to erect a powerful steam engine at the foot of a subterranean inclined plane, 2000 feet in length, and running right below the river which flows over the mine, to a perpendicular depth of 800 feet below its bed; or, failing that, to shut up the mine and throw 1500 people out of employment. It was, therefore, determined to adopt the former alternative, and a 20-horse steam engine, one of the patent combined hydraulic engines from Walker's

* The fire-box being removed at the end of each four years, would leave one only "half worn" at the end of ten years, into which a set of new tubes would be put. I therefore debit her half of the value of a *third box*, and take credit for half the value of old metal accordingly.

† In the renewing system I only allowed £ 425 for casualties. In this case I give a more liberal allowance, knowing well the value of constant care or "a stitch in time."

‡ I believe the most punctilious could not deny that, with an annual allowance for casualties in repairs of £ 60, and a provision of £ 450 every twenty months, (exclusive of fire-boxes and tubes,) for thorough repairs, £ 700 would well refit her, and turn her out in as effective a state as at first, *if not better*.

§ This ½d. per mile in a stock of two hundred engines will be equal to £125,000 in ten years, or £12,500 per annum, which *ought and eventually must be charged to revenue*.

‖ From the London Builder, November, 1850.

manufactory at Oliver's yard, City-road, was accordingly fitted up at that depth. Flues were, of course, requisite, and it was found advisable to conduct these across to the furthest bank of the river, and in a series of horizontal levels united by perpendicular shafts, so that the flue in sections rises like a flight of stairs to the surface. This flue is no less than two miles long and upwards, probably the longest flue in the world. The result was quite successful, as will appear from the following statement: —"We drew through Spurgin's shaft in October month 2988 kibbles of stuff with Walker's new underground engine: this machine is well constructed, and I have every reason to believe she will pump the shaft 150 fathoms deeper than it is at the present time. We have in these mines six steam engines at work at the surface, but the draft of the underground engine exceeds the whole. The consumption of coals is 5 cwt. in the twenty-four hours."

---

*Ship Canal between the Mediterranean and the Red Sea.**

Mr. Robert Stephenson is now on his way to Suez, to examine the route for a ship canal between the Mediterranean and the Red Sea. This survey is said to form part of a conjoint survey directed by England, France, and Austria, the former being represented by Mr. Stephenson, France by M. Paulin Talabot, and Austria by M. Negrelli. These latter have completed their labors, and on the completion of Mr. Stephenson's survey, the route will be determined on the conjoint evidence of the three reports. It is hoped the three powers will contribute the funds, if not the works will be conceded by the Pasha to a Joint Stock Company. Before the Academy of Sciences the survey of M. Bourdaloue, made in 1847, has been laid; it was under the direction of Mehemet Ali Pasha, and embraces the country between the Nile and the Red Sea, the levels being most carefully taken. The results differ very much from those of the French Commission of 1799.

The Bridge Failure at the South-Eastern Station, London Bridge.†

Experience is only true and valuable so far as it is on an extended basis, for, though called so, that is not experience which is merely local and partial. We are not always called upon to reproduce the same model or work on the same lines; but our practice is chiefly in the extension or particular application of existing examples. It therefore becomes of the greatest importance that we should have as wide a collection of facts as possible, so as to enable us more safely to calculate the result of any new direction, new application, or further extension; so, indeed, as to secure us from experimenting too far. We want, therefore, not only examples of success, but of failure; we want especially to know where any principle has been strained too much, that we may avoid such extreme, and where any detail has proved defective, so that we may apply the proper remedy. It has therefore always been considered, by our best authorities, as most expedient to record failures. Thus Smeaton prefaces the history of the Eddystone Lighthouse; thus, in the history of the Menai Bridge, the checks

* From the London Architect, for November, 1850. † Ibid.

received in experimenting, by which the ultimate application was arrived at, are carefully set forth for the guidance of future practitioners. We have therefore felt it highly desirable to report, as accurately as it is possible, a few particulars as to the failure of the Bridge over Joiner-street, at the carriage entrance to the South-Eastern Railway Offices of the London Bridge Station, which took place on Saturday, the 19th ultimo.

The bridge is of a peculiar construction, and consists of six compound girders of cast and wrought iron, patented by Captain Warren. The annexed engraving, fig. 1, shows part of one of the girders, rather more than half the length; and fig. 2, a transverse section of the roadway and two of the girders. There are in all six girders, placed 11 ft. 6 in. apart. The girder that broke is 41 ft. 6 in. long, and consists of a series of triplet cast-iron triangles, with a connecting-rib along the top and bolted at the joints, but there is no connecting-rib along the bottom of the girder; instead of which, they are held together by a horizontal tie, consisting in width of four wrought-iron bars, 6 inches deep by 1¼ inch thick and 13 feet in length, coupled together by 4½ inch bolts passing through a boss cast on the triangular stays, and also bolted to the intermediate triangles.

Fig. 1.

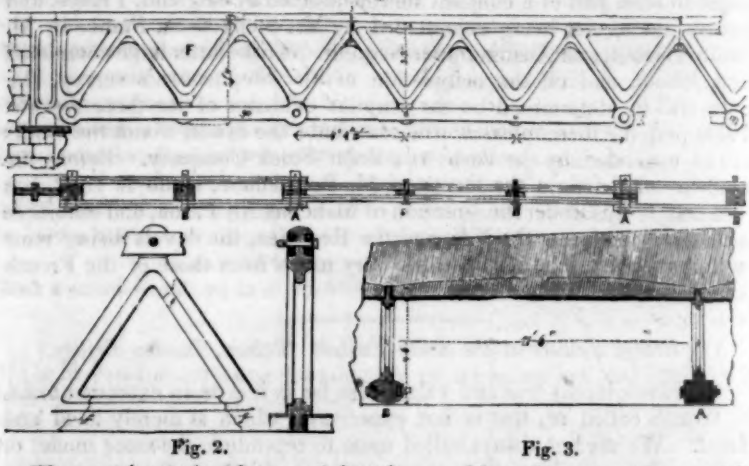


Fig. 2.

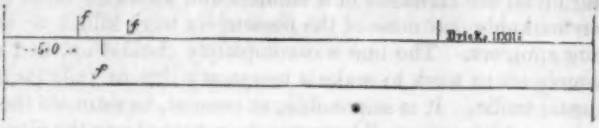
Fig. 3.

The cast-iron triangles are 4 feet deep, with a rib cast on the top 6 in. deep, making the whole height of the girder 4 ft. 6 in., and the length of the triplets 13 feet; the section of the cast-iron is T-shaped, 5½ inches wide on the back, and the depth the same; the thickness of metal 2 inches.

On the top of the girders are laid cast-iron plates, 11 ft. 6 in. long, with ribs bearing at each end on the girders; on these plates rest the materials which form the road, as shown in fig. 2. It must be observed, that the horizontal tie-bars are not intended to act as suspension bars; they are merely connected at the abutment piers to the ends of the cast-iron triangles. The points at which the bridge failed is marked with the letter *f*, where one of the cast iron stays broke asunder, and also the top rib, as shown in fig. 3, which is an enlarged view of the triangle which failed. It was only 5 feet from the abutment. The fracture is shown at *f*, *f*, *f*.

Various statements have been made as to the cause of the failure.

It was stated that the accident was caused by the girder being loaded with a large stack of bricks; but this is doubted, as the stack was at the opposite end, as shown in the annexed diagram. The stack of bricks



bearing on the girder was 11 feet square and 5 feet 6 inches high, equal to 666 cubic feet, which will give, at 72 feet to the thousand, between nine and ten thousand bricks, or a weight of about 22 tons. Another statement is, that the failure was caused by two carts which were on the bridge at the time; one of them, loaded with bricks, it is supposed passed over some obstacle, and caused the wheel to descend suddenly with great force. Whether this be so or not, we cannot pretend to say; but if the bridge had been properly constructed, with a cast iron girder 41 ft. 6 in. long, and of the great depth of 4 ft. 6 in., it ought not to have broken down with any such force. For ourselves, we are decidedly averse to these compound girders of wrought and cast iron. The contraction and expansion are unequal; and, consequently, the strain must be constantly varying, while the slightest deflexion of the wrought iron must cause the cast iron to snap asunder.

If this bridge had been constructed with a series of triangles, cast with a connecting-rib at the bottom and a broad flange on the underside equal in weight to the wrought iron, it would, in our opinion, have stood and borne a weight far greater than this compound girder bridge.

At the time we went to press, they were testing the bridge, and had a dead load when we left of 30 tons on a pair of girders. With a load of 20 tons on the pair, the deflexion was 0·20 of an inch.

Figs. 1 and 2 are drawn to a scale of $\frac{1}{8}$-in., and fig. 3 to $\frac{1}{4}$-in. to a foot.

Our English friends and their imitators here, are much shocked at the carelessness and mismanagement on our railroads, and it must be confessed not without cause. How will they like the following as a matter of comparison?

*Lancashire and Yorkshire Railway—Frightful Collision.**

On Friday last, about six o'clock, a fearful collision took place on this line, near the Huddersfield Junction, by which an immense amount of damage has been done to the stock of the Company, three engines being destroyed and a train of carriages knocked to pieces. The accident appears to have arisen as follows:—An engine which had been undergoing repairs in the engine shed on the main line, close to the junction, was being driven on, in order to its being shunted on to the line on which it was to be worked, and by some singular mismanagement was brought into violent collision with the passenger train from Bradford. The shock was so violent as to smash completely the engine and tender as well as

* From the London Railway Magazine, for November, 1850.

the engine belonging to the passenger train. The passengers, in alarm, jumped out of the carriages, but had hardly time to become conscious of their fortunate escape when a goods train dashed into the standing train, doubling up all the carriages in a moment and knocking them to shivers. It was remarkable that none of the passengers were killed or injured by the flying splinters. The line was completely choked up, and men were immediately set to work to make a temporary line of rails for the transit of the usual traffic. It is impossible, at present, to estimate the extent of the damage. An inquiry will be promptly instituted into the circumstances connected with the catastrophe, Capt. Laws having repaired to the spot immediately on receipt of the telegraphic news of the accident.

For the Journal of the Franklin Institute.

Advantages of using Fresh Water in the Boilers of Sea Steamers.

In steam boilers using salt water, it is necessary to extract or blow out a portion of the partly saturated water, at intervals or by a continuous process, to prevent a deposit of solid matter on the internal surfaces. The water blown out or extracted being much hotter than when it entered, must be the cause of an increased consumption of fuel, and may be explained or estimated as follows:

Sea water contains about one pound of salt and other solid matter in every 32 lbs. of water; its density is then called $\frac{1}{32}$, being $\frac{1}{32}$d part of salt, &c. When reduced by evaporation to half that quantity, the same amount of salt is still in that water, and is then in the proportion of 2 lbs. of salt to 32 lbs. of water, or at the density of $\frac{2}{32}$, &c.

It is evident that when keeping the water in the boiler at a density of $\frac{2}{32}$, one part is used for steam, and an equal quantity must be blown out; then as much salt, &c., will go out in one gallon or foot as entered in two gallons or two feet, and as long as this proportion to that evaporated is blown out, the water in the boiler will be kept at that density.

If the water in the boiler is kept at the density of $\frac{3}{32}$, then two parts will be used for steam, and one part must be blown out; then as much salt, &c. will go out in one part as entered in three parts.

Taking the latent heat of steam at 990°, sensible heat 212° = 1202°, the total heat in steam.

The quantity of heat necessary to evaporate one volume of water, is 1202°, less the temperature of the feed water entering the boiler, which is generally about 100°; taking this from the sensible and latent heats = 1202 — 100 = 1102°, which must be imparted to it to cause it to assume the form of steam.

The part or water blown out has to be raised from the temperature of the water entering to that leaving the boiler. Water entering 100°, that blown out 250°, difference or loss, 150°.

The proportion or loss is shown as follows:—Suppose two volumes of water enter the boiler, and the density is to be kept at $\frac{2}{32}$:

One volume is formed into steam and requires . .	1102°
One volume is blown out containing	150°
Quantity of heat required . . .	—— 1252°

The 150° blown out, being necessary to keep the boiler from incrustation, is the part lost; therefore, $\frac{1252}{150} = {}_{8\cdot\frac{1}{4}}$ part, equal to 11·98 pr. ct.

If the water in the boiler is kept at $\frac{3}{32}$, then, if three volumes of water enter the boiler, two are formed into steam.

Each requires 1102° = ...	2204°
One volume blown out containing . . .	150°
Quantity of heat required . . .	—— 2354°

As above, 150° blown out, then $\frac{2354}{150} = {}_{15\cdot\frac{1}{4}}$, equal to 6·37 pr. ct.

The following formula will answer for calculating it:—

Let H represent the sum of the sensible and latent heats.

D the difference in temperature of the water entering and that leaving the boiler.

T the temperature of the water entering the boiler.

E the proportion or quantity of water evaporated, the quantity blown out being constant, or represented by 1·000.

Then $\frac{H-T\times E+D}{D}$ = the $\frac{1}{}$ part of the heat lost.

Or $\frac{D}{H-T\times E+D}$ = the per cent. of loss.

The following is calculated by this formula:—

Example for the Density of $\frac{1\cdot5}{32}$.

H = 1202° T = 100° E = ·5 D = 150°

		Per cent.
	$1202-100=1102\times\cdot5=551+150=\frac{150}{701}$	21·39
At $\frac{1\cdot75}{32}$		15·30
At $\frac{2}{32}$	$1202-100=1102\times1+150 \quad =\frac{150}{1252}$	11·90
At $\frac{2\cdot25}{32}$		9·80
At $\frac{2\cdot5}{32}$	$1202-100=1102\times1\cdot5+ \quad \frac{150}{1803}$	8·30
At $2\frac{3}{4}$		7·20
At 3		6·37
At $3\frac{1}{2}$		5·00
At 4		4·30

The amount of loss stated above occurs when enough is blown to keep the water at the densities given. To keep the boiler clean, the water should not be allowed to get more dense than $\frac{2}{32}$ in the Atlantic Ocean, but, to be sure, it should be kept rather less in the Gulf of Mexico—not more than $\frac{1\cdot5}{32}$. In steamers having no indicator of this kind, they very probably keep the water less than $\frac{1\cdot5}{32}$, and most of them that have them keep it at $\frac{1\cdot75}{32}$, with a loss of from 14 to 21 per cent. of fuel. The above proportion of loss is when steam of two atmospheres is used; the loss increases as the pressure of steam used is greater, in consequence of the water being blown out at a higher temperature.

The saving in the cost of the fuel is but a small part compared to other advantages, such as increased durabilty of boilers, greater safety, increased stowage of freight, &c.

W. S.

Extract from an Account of the Chimney of the Edinburgh Gas Works, with observations on the Principles of its Strength and Stability. By GEORGE BUCHANAN, ESQ., F. R. S. E., C. E.*

The only point remaining to be considered, and to which Mr. B.'s attention was particularly called, was the expediency of protecting the building by a lightning-conductor. He had formerly, when the old chimney was erected, been consulted as to this, and considered it unnecessary, the height being moderate, and doubts being then entertained of the efficacy or expediency of such instruments. Much, however, has since been added to our knowledge and experience on this subject, and on the beneficial operation of conductors; so that he had no hesitation, the altitude also being so much greater, in recommending it. But having requested to be favored with the views of a friend, and high authority, Professor Faraday, he gave an extract from his letter as follows:

"The conductor should be of ½-inch copper rod, and should rise above the top of the chimney by a quantity equal to the width of the chimney at top. The lengths of rod should be well joined metallically to each other, and this is perhaps best done by screwing the ends into a copper socket. The connexion at the bottom should be good; if there are any pump-pipes at hand going into a well they would be useful in that respect. As respects electrical conduction, no advantage is gained by expanding the rod horizontally into a strap or tube—surface does nothing, the solid section is the essential element.† There is no occasion of insulation (of the conductor) for this reason. A flash of lightning has an intensity that enables it to break through many hundred yards (perhaps miles) of air, and therefore an insulation of 6 inches or 1 foot in length could have no power in preventing its leap to the brickwork, supposing that the conductor were not able to carry it away. Again, six inches or one foot is so little that it is equivalent almost to nothing. A very feeble electricity could break through that barrier, and a flash that could not break through five or ten feet could do no harm to the chimney."

"A very great point is to have no insulated masses of metal. If, therefore hoops are put round the chimney, each should be connected metallically with the conductor, otherwise a flash might strike a hoop at a corner on the opposite side to the conductor, and then on the other side on passing to the conductor, from the nearest part of the hoop there might be an explosion, and the chimney injured there or even broken through. Again, no rods or ties of metal should be wrought into the chimney parallel to its length, and, therefore, to the conductor, and then to be left unconnected with it."

In answer to some further inquiry, Professor Faraday again writes:—

"The rod may be close along the brick or stone, it makes no difference. There will be no need of rod on each side of the building, but let the cast iron hoop and the others you speak of be connected with the rod, and it will be in those places at least, as if there were rods on every side of the chimney.

"A three-fourth rod is no doubt better than a half-inch, and, except for

* From the London Architect, for November, 1850.

† The very reverse of what was formerly held by high authorities.

expense, I like it better. But a half-inch has never yet failed. A rod at Coutt's brewery has been put up 1½ inch diameter; but they did not mind expense. The Nelson Column in London has a half-inch rod—three-fourths is better.

"I do not know of any case of harm from hoop-iron inclosed in the building, but if not in connexion with the conductor I should not like it; even then it might cause harm if the lightning took the end furthest from the conductor."

The rod was constructed nearly according to these directions, of ⅝-inch copper, and the effect of it was very remarkably exemplified during the progress of the work. It was carried up regularly along with the building, and during storms, or a very electric state of the atmosphere, the electric fluid was distinctly preceived rushing down the rod, by a loud singing noise given out by it, arising from a tremor or vibration into which it was thrown, by a little play in the studs or eyes through which it passed in the building, and during these times the workmen were by no means fond of approaching too near it, but no harm ever occurred to any one from it.

---

*Cornish Engines.**

The number of pumping engines reported this month is 28. They have consumed 1913 tons of coal, and lifted 17,000,000 tons of water 10 fathoms high. The average duty of the whole is, therefore, 50,000,000 lbs. lifted one foot high by the consumption of 94 lbs. of coal.—*Lean's Engine Reporter, Nov.* 5.

For the Journal of the Franklin Institute.

Notes on Indicator Diagrams from the U. S. War Steamer "Spitfire."

By B. F. Isherwood, *Chief Engineer U. S. N.*

The accompanying indicator diagrams (Plate I.) were taken from the steam cylinder of the U. S. steamer "Spitfire" by me, while senior engineer of her during the late war with Mexico. I had taken every precaution to have the indicator in perfect order, and am convinced that the diagrams are strictly accurate. Nos. 1, 2, 3, and 4, were taken successively at intervals of about 10 minutes, on the 16th October, 1847, while steaming up the Alvarado river; there being throughout the whole time a steady, strong, aft breeze, with the foresail and jibs set. The expansion valve was inoperative, the steam communication with the boiler being open throughout the entire stroke of the piston.

No. 1 was taken with the throttle valve as close shut as it could be jammed. Steam pressure in the boiler above the atmosphere 13 pounds per square inch. Double strokes of piston, 8¼ per minute. Mean pressure throughout stroke, by indicator, 4½ lbs. per square inch.

No. 2 was taken with the throttle valve $\frac{1}{32}$d open. Steam pressure in the boiler above the atmosphere, 10 lbs. per square inch. Double strokes of piston, 12¼ per minute, Mean pressure throughout stroke, by indicator, 9·88 lbs. per square inch.

* From the London Railway Journal, for November, 1850.

No. 3 was taken with the throttle valve $\frac{1}{16}$th open. Steam pressure in the boiler above the atmosphere, 9½ lbs. per square inch. Double strokes of piston 13½ per minute. Mean pressure throughout stroke, by indicator, 12·84 lbs. per square inch.

No. 4 was taken with the throttle valve $\frac{1}{8}$th open. Steam pressure in the boiler above the atmosphere, 10 lbs. per square inch. Double strokes of piston, 15 per minute. Mean pressure throughout stroke, by indicator, 14·75 lbs. per square inch.

It is at once apparent that one object of taking these diagrams with the throttle valve successively jammed shut, $\frac{1}{32}$d, $\frac{1}{16}$th, and $\frac{1}{8}$th open, was to observe the phenomena of pressure in the cylinder caused by *throttling*. We are first struck by the inequality of the boiler pressure and of the initial cylinder pressure; the inequality becoming greater as the area of the passage from the boiler is decreased by *throttling*.

In Nos. 1, 2, 3, and 4, the speeds of the piston were respectively 99, 147, 162, and 180 feet per minute,—low velocities compared to that with which steam of 25 lbs. total pressure rushes into a vacuum, viz., about 96,000 feet per minute. Pambour, in his "*Theory of the Steam Engine*," states that the pressure in the cylinder depends wholly on the load upon the piston, irrespective of the area of steam passage, and that this dependency is not affected by the operation of throttling. In illustration of this hypothesis, he likens the piston to a loaded safety valve, which is of course in equilibrium when the steam pressure equals the weight or load, and rises with the slightest increase. In no point of view, however, can the piston be likened to a safety valve; the safety valve rises as soon as the pressure exceeds the load, *but does not continue to rise*, while the piston, on the contrary, moves as soon as the pressure exceeds the load, and *continues to move*. In the first case it is a mere balance of statical forces, in the second it is a dynamical phenomenon; and supposing the area of the steam passage from the boiler to be sufficiently large that the steam suffer no diminution of pressure from friction, *vena contracta*, condensation, &c., the pressure in the cylinder would be always the same as in the boiler, and the difference of load on the piston would affect only its velocity—not the pressure upon it; the lighter the load, the greater the velocity at which it would be moved, the pressure being the same,—the equilibrium with the pressure being maintained by the lighter load by its greater velocity. In confirmation of this, indicator diagrams Nos. 5 and 6 are given. In each case the steam pressure in the boiler was 12 lbs. per square inch above the atmosphere, and the throttle was $\frac{5}{16}$ths open; steaming in the Alvarado river; draft of water, &c., being the same. In No. 5, steaming against a moderate head wind, the initial pressure in the cylinder was 8¾ lbs. per square inch above the atmosphere, and maintained at that pressure to the point of cutting off; double strokes of piston per minute, 26. In No. 6, steaming with a fresh aft wind, foresail and jibs set, the initial pressure in the cylinder was 8½ lbs. per square inch above the atmosphere, and maintained at that pressure throughout the stroke, (the expansion valve being inoperative,) double strokes per minute, 32. In these instances, the normal load upon the piston, viz., the resistance of the vessel, was increased in the first by a moderate head wind, and decreased greatly in the last by the action of a fresh aft wind on the hull

and sails, yet the cylinder pressure in each case bore almost exactly the same relation to the boiler pressure, the difference of load on the piston being evidenced by the difference of its velocity only. I shall consider, therefore, this theory of Pambour as erroneous, and that the indicator diagrams prove that the difference between the boiler and cylinder pressures depends wholly on the area of the passage of communication, the effect of friction, condensation, &c., apart; for we perceive that in Nos. 1, 2, 3, and 4, where the load upon the piston was exactly the same, viz., the resistance of the vessel, the difference between the boiler and cylinder pressure was affected by each variation of throttle, and the velocity with which the load was moved varied with the pressure.

To return to diagrams 1, 2, 3, and 4, we observe that the pressure at which the steam enters the cylinder continues for a variable fraction of the stroke, and then gradually declines until about $\frac{5}{8}$ths of the stroke is completed, thence continuing equal for the remaining $\frac{3}{8}$ths.

It might be supposed that, as the velocity of the piston increases from the beginning to the middle of its stroke, and thence decreases to the end, (the throttle opening remaining the same,) that the pressure would correspond inversely with this velocity, being greatest at the beginning of the stroke, decreasing to the middle, and thence increasing to the end, where it would equal the pressure at the beginning. A little reflection, however, on the laws of elastic fluids, will show us that the diagrams are such as should be given. Let us suppose the piston at the commencement of its stroke, and let us further suppose it to have performed a fraction of its stroke, leaving a vacuum by its space displacement; the steam, rushing in from the boiler, fills this space with a certain pressure; the piston now continues to advance another equal fraction of its stroke, doubling its original space displacement; the steam contained in that space, will, by the well known law of fluids, be only half its first pressure, and the steam from the boiler will still rush in, but with a much less velocity than before. Its original velocity would be that due to a body falling from a height, equal to the height of a homogeneous column of steam having a weight equal to the original pressure, corrected by a coefficient representing the decrease of velocity caused by throttling.

But this velocity in the second fraction of the stroke would be lessened by the pressure of the steam already present, in consequence of the expansion of that which filled the first fraction. The original velocity will be lessened by the quantity due to a body falling from a height equal to the height of a homogeneous column of steam, having a weight equal to this expansion pressure. It will not, therefore, fill the cylinder with a pressure equal to the first, which will also be further reduced by the reduction of time for performing this fraction of the stroke, consequent upon the increased speed of the piston. Again, suppose the piston to perform another equal fraction of its stroke; its space displacement is now triple its first displacement, and the two volumes of steam contained in its first two displacements will now be expanded into three volumes, and consequently be two-thirds the pressure. Supposing, which is in fact the case, that the ultimate steam pressures in the first and second displacements varied but little, it will be obvious that two-thirds the ultimate pressure present at the end of the second displacement is greater than one-half the

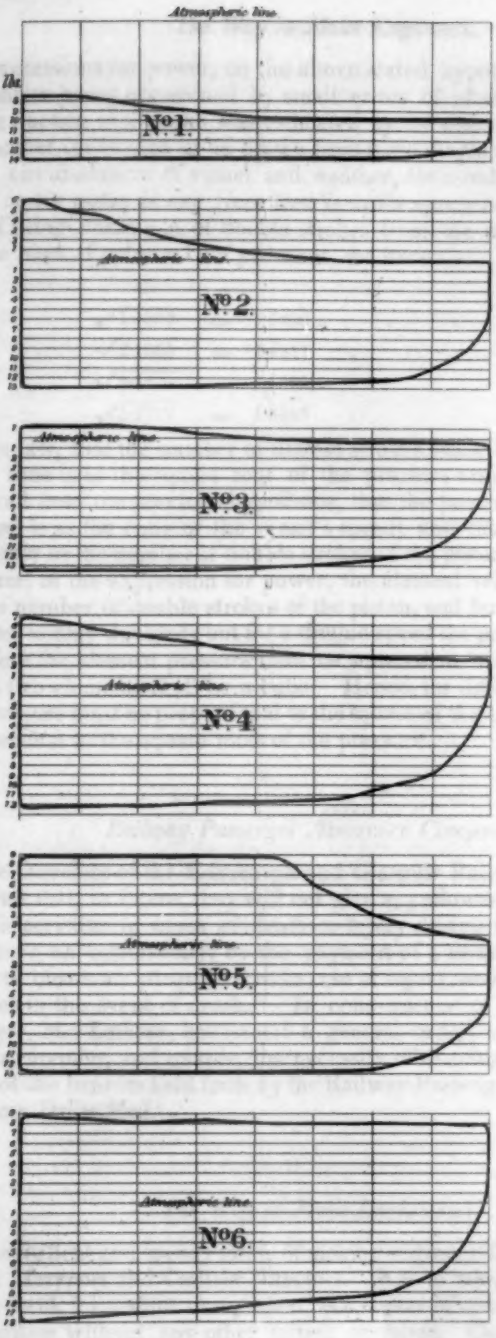
ultimate pressure present at the end of the first displacement; consequently the velocity with which the steam will rush into the third displacement, against two-thirds pressure, will be less than against one-half pressure, and so on for any number of equal displacements, the entering velocity of the steam becoming less and less with each additional displacement, because the pressure already present becomes greater and greater as the space to be expanded through evidently becomes less and less proportionally to the bulk of steam to be expanded. Did the piston, therefore, move with an uniform velocity, the line of steam pressures would be a curved line continually approximating a straight line, but never becoming straight though continued to infinity. This curved line is, however, modified in the diagrams by the unequal velocity of the piston in different parts of its stroke.

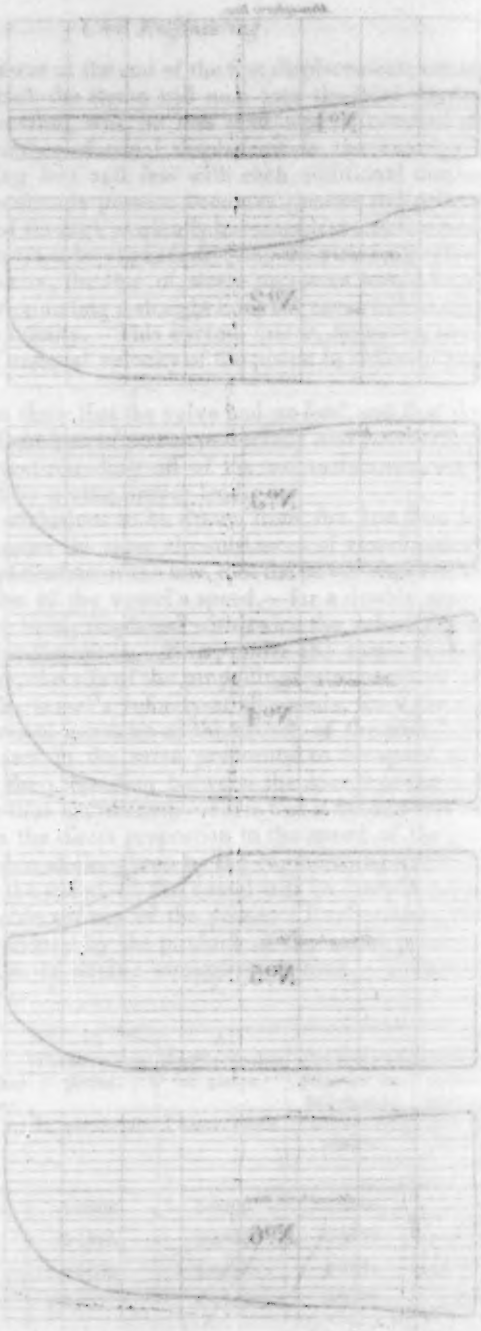
The diagrams also show that the valve had no *lead*, and that there was, in consequence, a slight loss of power potentially and economically, evidenced by the too great rounding off of the exhaust corner,—a defect I afterwards remedied by giving proper lead.

There are other conclusions to be drawn from the first four diagrams, (which were taken under the same circumstances of vessel and weather,) one of which is a verification of the law, that the power required to propel a vessel is as the cube of the vessel's speed,—for a double speed, twice the quantity of water being displaced with twice the velocity, the power also acting over twice the space. Now, under the same circumstances of vessel and weather, the *slip* of the propelling instrument will be a constant proportion of the vessel's velocity at all speeds, for if the resistance of the water to the vessel increases as the square of the speed, the same resistance also increases in the same proportion to the speed of the propelling surface, and the proportion between the speeds of the vessel and propelling surface is thus maintained. From this it follows that the speed of a vessel will be in the direct proportion to the speed of the propelling surface, and the double stroke given by the engine being directly proportional to this speed, the speed of the vessel will be directly proportional to the number of double strokes of the piston. Furthermore, the power will evidently be expressed by the product of the mean pressure on the piston and the number of double strokes per minute. Tabulating these quantities, we have:—

Pressures on piston in pounds per sq. inch.	Double strokes of piston per minute.	C. Pressures on piston. Proportionals.	A. Double strokes of piston. Proportionals.	Products of pressure on, and double strokes of, piston.	B. Cube roots of products of pressure on, and double strokes of, piston.
4·50	8·25	1·0000	1·0000	1·0000	1·0000
9·88	12·25	2·1955	1·4848	3·2599	1·4828
12·84	13·50	2·8533	1·6363	4·6691	1·6714
14·75	15·00	3·2777	1·8181	5·9597	1·8131

In this table, column A gives the expressions for speed, and column B


Atmospheric line
No. 1.
Atmospheric line
No. 2.
Atmospheric line
No. 3.
Atmospheric line
No. 4
Atmospheric line
No. 5.
Atmospheric line
No. 6.



the expressions for power, on the above stated hypothesis, the slight discrepancies being occasioned by small errors of observation, particularly as the fraction of a stroke was estimated by the eye.

Another conclusion to be drawn from these diagrams is that, under the same circumstances of vessel and weather, *the number of double strokes made by the piston in any given time is as the square root of the pressure on it.* Taking column A of double strokes from the above table, and the square roots of column C of pressures, we have:—

C.			A.
$\sqrt{1{\cdot}0000}$	=	1·0000 . . .	1·0000
$\sqrt{2{\cdot}1955}$	=	1·4817 . . .	1·4848
$\sqrt{2{\cdot}8533}$	=	1·6892 . . .	1·6363
$\sqrt{3{\cdot}2777}$	=	1·8105 . . .	1·8181

The law, that the number of double strokes made by the piston in any given time is as the square root of the pressure on it, might have been deduced from the previous hypothesis, that the power required to propel a vessel is as the cube of the vessel's speed; and that the vessel's speed is directly as the number of double strokes of the piston in any given time. Because, in the expression for power, the element velocity is represented by the number of double strokes of the piston, and for a double speed this element is only doubled; but for a double speed the power must be cubed; therefore the element pressure must be squared in order that the product of the two elements shall be a cube. Hence, for different speeds we find the pressure must be proportional to the square of the speeds, or the speeds proportional to the square roots of the pressure.

---

*Railway Passenger Assurance Company.**

The Directors of the Edinburgh and Glasgow Railway Company have resolved that, in future, they will not give any allowance or compensation to their servants in cases of death or injury arising from accidents, "as they have an opportunity, by the payment of a small premium periodically, to insure an adequate sum in case of injury, and to provide for their families in the event of death." In consequence of this resolution, the manager, Mr. Latham, has issued a general order, urging upon engine-drivers, firemen, and guards, the necessity of availing themselves, forthwith, of the benefits held forth by the Railway Passenger Assurance Co.—*Glasgow Daily Mail.*

The Way to Make Engineers.†

An excellent and speedy mode of making engineers has been discovered by the Maryport and Carlisle Directors. It is to take on a young man at 12s. a week for a short time, when, as a matter of course, he will become an engineer without any other tuition or labor. Confound Stephenson

* From the London Railway Journal, for November, 1850. † Ibid.

and other engineers, what right have they to make the high charges they do when an ignorant fellow put upon a railway at 2s. a day becomes a railway engineer in a few weeks? "It is too bad."

We know better here on our railroads, but the above process is very much the one by which our engine drivers and steamboat engineers are manufactured. Hence our numerous and rapidly increasing explosions, and the great loss, not only of money, (as on an ill-constructed railroad,) but of life. See the article on this subject in our January number.

F.

AMERICAN PATENTS.

List of American Patents which issued from December 17, 1850, *to January* 7, 1851, *(inclusive,) with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

27. For *Improvements in Mills for Sawing with Circular Saws;* Orlando Child, Granville, Putnam county, Illinois, December 17.

Claim.—"What I claim as new in my invention, is, 1st, the springs G and G^1, carrying the journal boxes g and g^1, attached and arranged in the manner substantially as herein described, for the purpose of guiding the saw, but at the same time allowing a sufficient degree of end play to the spindle to admit of its accommodating itself to the lateral springing of the log.

"2d, Arranging the saw N and its spindle on the swinging frame, which is adjustable so as to bring the saw N in any required position in a line forming part of a circle round the axis of the saw D, and adjusting the said saw N either in a line with, or to the right or left of, the saw D, by means of the slot in the spring G^1, through which the bolt passes, in the manner herein described, or in any manner substantially the same."

28. For *Improvements in Machinery for Doubling and Twisting Silk, &c.;* Joseph Conant and Lucius Dimock, Northampton, Hampshire county, Massachusetts, December 17.

Claim.—"What we claim as new, is so constructing the catch-bar that all the threads or silk, either before or after being twisted, may be secured by the catchers simultaneously, by simply bringing the bar with its catchers down upon the threads, and whilst in that position, causing all the helical springs to act on the catchers at the same time, by suddenly disengaging the slide lock plate from the end of the bar, the mortises in the said plate being so formed as to allow each catch to be opened separately without the aid of the lock plate; or all to be opened simultaneously by moving said lock plate longitudinally in the manner herein set forth."

29. For an *Improvement in Apparatus for Emptying Privies;* Florimond Datichiry, City of New York, December 17.

"My improvements consist in the addition of a chamber or gasometer to the receiver of the apparatus for emptying vaults of privies by atmospheric pressure; the object being to allow space for the gases contained in the suction pipes and those arising from the fecal matter, without their occupying part of the receiver itself, and the gasometer being separated from the receiver and communicating with it only by a small passage, the matter (which entirely fills the receiver in consequence of the additional space provided for the gases) has but a small portion of its surface exposed to the gases, and is thus prevented from becoming mixed with them."

Claim.—"What I claim as new therein, is the gasometer connected with the receiver as described, for the purpose of keeping the gases separated from the fecal matter, and pre-

venting their mixture as set forth, and serving also as a reservoir for the compressed gases from which the power for expelling the contents of the receiver is obtained."

---

30. For an *Improvement in Carriages;* Edward Everett and Charles Everett, Jr., City of Washington, D. C., December 17.

Claim.—"What we claim as new therein, is the joint on which the fore carriage turns, when placed in rear of the fore axle, in combination with the segment on which the end of the perch rests, substantially as described, for the purpose of allowing the carriage to be turned in a small space, without having the fore wheels to run under the body or interfering with the hind wheels."

---

31. For *Improvements in Machinery for Cutting and Bending Sheet Metal;* Joseph F. Flanders, Newburyport, Essex county, Massachusetts, December 17.

Claim.—"I claim the improvement in the bending mechanism, the same consisting in the combination of the conic or approximately conic roller or projection with the cylindric part or roller, and with the circular disks or holders, in the manner as above described, and so as, when pressed against the tin, to gradually bend it over and down upon the disk or holder, so as to enable the roller to pass over and upon the tin, and complete the bending of it down upon the periphery of the holder.

"I also claim the improvement in the construction of the gauge, whereby it is adapted to operate when the tin plate is rotated in a vertical plane, such improvement consisting in arranging its supporting journal at an inclination to the horizontal plane, and applying a weighted arm or its mechanical equivalent to the gauge as seen in the drawings, or so that the gravitating power of the weighted arm shall restore the gauge to its original and proper position under the holders, after it has been freed from the pressure of the surplus tin, or part removed by the cutters."

---

32. For an *Improvement in Seed Planters;* Joseph W. Fawkes, Bart township, Lancaster county, Pennsylvania, December 17.

"The nature and object of my invention and improvement consists in sowing grain, wheat, and oats with more constant regularity, by curved slots or apertures in the horizontal cog wheels, as arranged under the hopper, with the devices for gearing and ungearing, and the adjusting shovels."

Claim.—"What I claim as my invention, is the peculiar construction of the adjustable shovels to clear the mouth of any obstructions.

"I also claim the mode and manner of sowing the grain through the slots, as herein described."

---

33. For *Improved Expansion Gear for Horizontal Engines;* Samuel H. Gilman, Cincinnati, Ohio, December 17.

"The main object of this invention is to provide for a horizontal engine, operated by puppet valves, an economical form of cut-off movement capable of adjustment to any point of the stroke, the mechanism being of such a structure as to be adjustable either while the engine is in full activity or otherwise."

Claim.—"What I claim therein as new, is withdrawing the sliding tongue of the lifter of the supply valves of steam cylinders, so as to trip the valves at any desired point, by an adjustable prong which is made to slide upon the arm holding the usual fixed prong, by the action of a tappet on the rock shaft, when this adjustment is effected by means of the shackle and links within the steam chest, the shackle and links being elevated or depressed by an index arm without-side the steam chest, and the whole being arranged and operating substantially as herein described."

---

34. For a *Machine for Making Eyelets;* Lucien E. Hicks, Assignor to Wm. A. Churchill and James Stanley, Berlin, Hartford county, Connecticut, December 17.

"The nature of this invention consists in so arranging and combining various mechanical elements and devices in a single machine as to facilitate the manufacture of metallic eyelets, the machine forming one eyelet complete by each revolution of the principal shaft."

Claim.—"What I claim as my invention, is the sliding bolster, constructed with its two dies *c* and *e*, and aperture, in combination with the feeding tube, punches, and clearers;

the whole being constructed, arranged, and operated substantially in the manner and for the purpose herein set forth."

---

35. For an *Improvement in Grain Cradle Fingers;* Joel Houghton, Ogden, Monroe county, New York, December 17.

Claim.—"What I claim as my invention, is the insertion of a metallic plate into the edge of a cradle finger by means of rivets or other fastenings, so as to keep the plate and finger permanently attached together and in their place, and thereby effectually prevent the finger from straightening or springing back when used in damp grain—prevent the grain from wearing it away, and prevent the grain from sliding endwise off the cradle before the cradler gets it round into his own swath."

---

36. For an *Improved Sash Fastener;* William H. Lazelle, Hartford, Connecticut, December 17.

"My improvement consists in using a cam secured in a slot or mortice in a plate, by means of the shaft of the knob or handle passing through holes in ears or projecting pieces on the back side of the plate, serving as a fulcrum pin; and also (by means of a lip on this fulcrum pin and a slot in one of the projections) as a fastener to prevent the cam from being turned back by any force whatever, thus locking or fastening the lower sash down with absolute safety, while the knob or handle serves to turn the cam back when it is desired to raise the sash, in the first instance, and to let it down at all times."

Claim.—"What I claim as my invention, is the combination of the cam with the plate, when these are combined with the shaft and lip for turning back the cam when necessary, and locking it to fasten down the lower sash, when the whole is constructed, arranged, and combined substantially as herein described."

---

37. For an *Improved Arrangement of Steam Engine;* Richard F. Loper and John W. Nystrom, Philadelphia, Pennsylvania, December 17.

"Our invention consists in a particular arrangement of the beams, connecting rods, and crank shaft of the two cylinders of a double cylinder engine, by which the crank shaft is forced to make a complete revolution while the piston of one engine is making a single stroke, or is traveling from one end of the cylinder to the other, while at the same time the arrangement of the various parts is such that the crank to which the two connecting rods are applied cannot be placed in any position in which the power acting upon one of the connecting rods is not tending to turn it. The crank shaft of our engine, therefore, makes twice as many revolutions as that of engines of the usual construction, in which this shaft makes but one revolution for each double stroke of the piston, while at the same time this increase in speed is obtained without the employment of cog gearing, or of any similar device."

Claim.—"What we claim as our invention, is the arrangement herein set forth of the beams, connecting rods, and crank of the two cylinders of a double cylinder engine."

---

38. For an *Improved Composition for Making Cores for Casting;* Edward Rees, Cincinnati, Ohio, December 17.

Claim.—"What I claim therein as new, is the use of white of egg as a component in the preparation of loam for cores and other similar things intended for contact with molten metal, in the manner herein described, limiting myself to that use of white of egg, but not limiting myself to the precise proportions mentioned, while the same result is obtained by the said addition to the ingredients ordinarily used in loam for cores."

---

39. For an *Improvement in Mills for Grinding;* John Rogers, Jr., Jackson, Jackson county, Michigan, December 17.

"My improvement relates to the manner of supporting the bed stone by a universal joint upon a lever raised and lowered by a screw for raising and lowering the bed stone, the universal joint rendering the bed stone self-adjustive in relation to the runner.

"Also to the formation of an annular space between the stones and runner, in combination with a funnel-shaped space beneath the bed, for the free discharge of the meal and increase of draft.

"Likewise in the arrangement of a fan and fan-case, in connexion with the inclined spout leading from the bottom of the funnel-shaped portion of the case, for promoting a downward draft through the machine, for keeping the meal cool, preventing it from sweating or clogging, and for promoting a free discharge of the meal as fast as it is ground."

Claim.—"What I claim is hanging the bed stone (when the shaft or spindle to which the runner is attached passes through the same) by means of the before described universal joint, in combination with the lever and screw as aforesaid."

---

40. For an *Improvement in Oscillating Seeding Cylinders;* David E. Rohr, Charlestown, Jefferson county, Virginia, December 17.

Claim.—"What I claim as new and of my invention, is oscillating the seeding cylinder upon its axis for the supply and discharge of the seed as described, by means of the combination of the lever, spring, and pins with the propelling wheel, as described."

---

41. For an *Improved Instrument for Laying Down Curves of Ships' Timbers;* Chas. Scales, Bath, Lincoln county, Maine, December 17.

"My instrument consists of an outer flexible rib, by means of which the outside curve of the timber is marked down; of a similar inner rib, by means of which the inside curve of the same timber is marked; of a series of cross-ties, by which the two ribs are connected, and of a clamp bar and clamp screws, by means of which the mould is fixed in any required shape."

Claim.—"What I claim as my invention is the adjustable mould, constructed substantially as herein set forth, so that it can be set to the outside and inside curves of the timbers of a vessel, and can then be used to mark them upon the wood of which they are to be formed."

---

42. For an *Improvement in Artificial Legs;* W. C. Stone, Boston, Massachusetts, December 17.

"The nature of my invention consists in providing a stop in the knee joint of the artificial leg, to prevent the revolution of the joint until the step is taken, as, in the case of other legs, there is nothing to prevent the outslip of the joint, and consequently a fall."

Claim.—"What I claim as my invention, is the application of the whole action from the heel up to the knee joint in the artificial leg, which action prevents the knee joint from turning, slipping, or revolving out in the act of stepping, as herein described, using for that purpose the aforesaid springs, rod, lever, and pins, or any other substantially the same and which will produce the intended effect."

---

43. For an *Improvement in Lamps for Lighting Gas Burners;* Robert Thompson, Lowell, Middlesex county, Massachusetts, December 17.

Claim.—"What I claim as my invention, is the protector as made and applied to the lamp, and so not only to be capable of exploding or inflaming the gas brought into contact with it, substantially as specified, but of protecting fibrous matters which may come in contact with the protector, from direct exposure to the flame."

---

44. For an *Improvement in Fanning Mills;* Eleazer Bless, Minerva, Mason county, Kentucky, December 17.

Claim.—"What I claim therein as my invention, is the supporting and regulating the motion of the sieves by means of the rollers, or their equivalents, and the spiral springs so arranged as to press the shoe or sieve frame down upon the rollers, steadying its motion, and, to a certain extent, preventing any jar at the end of each vibration, substantially in the manner and for the purpose as herein set forth."

---

45. For an *Improvement in the Manufacture of Starch from Maize;* Thomas Bragg, West Milton, Ohio, December 24.

"The object of my improvement in the manufacture of starch, is the more complete extraction of the starchy matter by the liberation of that portion which, in the natural grain,

is too intimately blended with insoluble matter to yield to the ordinary disintegration and maceration."

Claim.—"Having thus fully described the nature of my invention, and my process for the extraction of starch from corn and other similar grain or seeds, what I claim therein as new is the method substantially as described, of extracting from maize, and other grain or seeds subject to rapid putrescent decomposition, that portion of the starch which is inextricable either by mechanical means or by fermentation of the meal, by the subjection of the unbroken grain to an incipient germination, which is arrested at that stage of the vegetative action at which the starch that exists in an insoluble combination, being liberated, is capacitated for precipitation along with the free starch, by any of the usual processes of maceration and elutriation."

---

46. For an *Improvement in Dampening Paper for Copying Presses;* Joseph Burnham, Philadelphia, Pennsylvania, December 24.

"The object of my invention consists in a tablet of some substance which is impermeable to moisture, and whose surface is roughened or burred up evenly throughout its whole extent, in such manner that the inequalities thereon will retain a sufficient amount of moisture to dampen a sheet of paper to the requisite degree."

Claim.—"I do not confine myself to the employment of sheet metal as a material for my dampening tablets, as many other impermeable materials are well suited to the purpose; but what I claim as my invention is a dampening tablet constructed substantially as herein described, of some impermeable material."

---

47. For an *Improved Means for Preventing Back-Lash in the Feed Motion of Planing Machines;* Thomas H. Burridge, Jersey City, New Jersey, December 24.

"The nature of my invention consists in the use of two racks, placed parallel and fixed to the traveling table, which racks are driven by two separate pinions on the same shaft, one of which is firmly keyed to the shaft, and the other is fitted loose, but with a driving adjusting arrangement which will admit of the adjusting pinion being slightly moved, and the shaft also slightly turned in the opposite direction, so that when the teeth in the pinions and racks have too much play, caused by wear, the 'back-lash' consequent upon wear in the ordinary way, is, by this adjusting arrangement, obviated, the pinions being set so that the teeth of either pinion will bear only on one of their sides against the teeth in the racks, one driving the teeth forwards and the other backwards alternately, the shaft on which are the pinions being driven by a screw and pinion."

Claim.—"What I claim as my invention, is the combination, in the traveling table motion of planing machines, of two racks, L^1 L^2, sheets 1 and 2, operated on by two separate pinions, M N, one of which is made adjustable in the manner shown, by set screws *m m m m*, with accompanying parts, and so arranged that the pinions M N may be set as to alternately operate, the one to drive the table forwards, and the other to drive it backwards, for the purposes herein set forth, and operating as shown and described, or in any manner substantially the same."

---

48. For *Improvements in Hydraulic Blowers;* Jeremiah Darling, Cincinnati, Ohio, December 24.

"My invention consists of an apparatus by which a continuous and powerful blast is produced for smelting, forging, and other purposes, which works with little friction and requires but a small power to drive it, and being simple in its construction is not expensive; and it is not liable to get out of order. One great advantage over cylinder blowers is, that it does not require to be stopped to pack pistons, &c., which, in smelting operations, frequently produces injury to the iron by stopping the blast. All that is necessary to keep this apparatus continually in action, till worn out, is to keep up the supply of water, which can be done while in action."

Claim.—"Having thus fully described my improvements, what I claim therein is, 1st, the apparatus substantially as above described, consisting of a revolving drum, partly filled with water, and provided with chambers, valves, &c., which cause the air to enter at one hollow journal, and escape in a compressed state at the other, for the purpose of producing blast as set forth.

"2d, I claim the manner of separating the water accidentally mixed with the blast, by means of the partitions and cells in the chambers (*l* and *n*.)

"3d, I claim the pipe (*u*) for conducting the water accumulated in the chamber (*n*) to the hollow journal (*c*) and returning it to the drum, substantially as described."

---

49. For an *Improvement in Vats for Tanning Hides;* Lewis C. England, Williamsburgh, New York, December 24.

"The nature of my invention consists in an improvement on such vats, or tanks, used in the various processes of preparing leather, as are fitted with revolving handles. In vats of the usual make, the skins or hides cannot be kept in a state of agitation throughout the whole of the vat, as some will lodge in the lower corners, &c., and the handling of the remainder then requires a greater expenditure of power, in consequence of the increased resistance. By the construction in such vats of a semi-cylindrical bottom of slats, I am enabled to effect the handling of the hides, in the various processes of liming, bailing, scouring, washing, and tanning, far more rapidly and economically than in vats of the usual make."

Claim.—"I do not claim herein the use of the revolving handles, as already secured to me by letters patent bearing date of June 19th, 1847; but what I claim as of my own invention, is the *slats*, as described, in combination with the vat and the handles, substantially in the manner and for the purposes herein set forth."

---

50. For an *Improvement in Printing Presses;* Charles W. Hawkes, Boston, Massachusetts, December 24.

"My improvements are applicable to printing any size of sheets, large or small, but more particularly for small job work and card printing."

Claim.—"What I claim as my invention, is, 1st, the combination of the rocker shaft, C, and rocker arm, D, and the fork lever, A, with the swing platen, substantially in the manner and for the purpose herein set forth.

"2d, I claim for feeding cards, the slide, *k*, and rods, *m*, in combination with the swing platen, substantially in the manner and for the purpose herein set forth.

3d, I claim the combination and arrangement of the gauge, *s*, the spring, *u*, the lever, *v*, the trip, *w*, the catch, *x*, and the wire, *y*, with the swing platen, in the manner and for the purpose herein described.

"4th, I claim the knees, *c*, to support the inking rollers, in combination with the spiral springs, *h*, threads, *f*, the plate, *l*, and the set screws, *k*, substantially in the manner and for the purpose herein set forth."

---

51. For an *Apparatus for Operating Window Blinds and their Slats;* John Jones, Clyde, New York, December 24.

"The nature of my invention consists in an arrangement, by which the blind or slats may be opened and closed, and the blind locked from the inside of the building without raising the sash.

Claim.—"What I claim as my invention, is the combination of the shaft, P, having two levers, J G, thereto attached, with the connecting rod L, attached to the blind or shutter; the whole arranged substantially as herein described, and constituting a blind or shutter opener.

"I also claim, in combination, the hollow shaft, I, having a lever, D, at one end of the same, and two arms, B H, at its other extremity; the bolt A, with its bracket N, and slot Q; and the two pins C C, attached to the blind rod E; the whole forming an apparatus for working the slats and fastening the blind when closed, substantially as herein described."

---

52. For an *Improvement in Attachments to Pumps for Agitating the Surface of the Water in the Well;* William D. Mayfield, Elkton, Kentucky, December 24.

"The object of my invention is to keep the water in a cistern or well, when the water is drawn by a pump, equally as fresh and sweet as when drawn in a bucket, and the nature of my invention consists in the application, to the piston rod of a pump, of what I term an agitator, which, floating on the water, will, as the piston rod is operated, disturb the top of the water, and thus prevent its stagnation."

Claim.—"What I claim therein as new is the application of a series of floating blades to the rod that operates the plunger of pumps for cisterns or wells, for the purpose of agi-

tating the surface of the water, and this I claim, whether the blades and rod are reciprocally prepared in the manner described, or in any other equivalent way to effect the same purpose."

---

53. For an *Improvement in Instruments for Vaccinating;* Henry Mollish, Walpole, New Hampshire, December 24.

"The nature of my invention consists in combining with the lancet an apparatus for taking up and discharging the vaccine matter into the puncture made to receive it, before the lancet is withdrawn."

Claim.—"What I claim as my invention, is the sliding lancet B, when in combination with the cylinder A, charger E, piston H, and springs J and K, in the manner and for the purpose above set forth."

---

54. For an *Improved Method of Loosening Metallic Cores from Hollow Castings;* John C. Parry, Pittsburg, Pennsylvania, December 24.

"It is a well known fact that iron shrinks as it cools, and a kettle of the kind I am describing will shrink one-eighth of an inch to every foot in diameter."

Claim.—"What I claim as my invention in the above described mode of casting, is the application of cold water to the core or inner metallic flask of a hollow casting when the metal begins to cool, so as to loosen the core, (by the contraction caused by the action of the water,) sufficiently to remove it without injury to the casting."

---

55. For an *Improvement in Port Folios;* James Shaw, Providence, Rhode Island, December 24.

A new and improved "portfolio designed to keep sheets of music, drawings, engravings, or other papers in, and so arranged and constructed that the sheets may be successively added to, and firmly bound or secured therein, so as to preserve them while in use, in like manner as if they were bound into a book in the usual mode."

Claim.—"What I claim as my invention, is the roller back, in combination with the strings stretched thereon, the device, or its equivalent, at the ends, for securing and for tightening or loosening the strings, and the binders to secure the sheets in their proper places."

---

56. For *Improvements in Looms for Weaving Figured Fabrics;* Samuel T. Thomas, Lowell, and Edward Everett, Lawrence, Massachusetts, December 24.

"Our improvement in the jacquard loom consists of an arrangement and combination of harness shafts or bars, as a substitute for the knot cord, by which arrangemement we distribute the many mail cords or heddles of the knot cord at any required distance apart, and disconnected from each other, along the length of the horizontal harness shafts or bars, by which a very material advantage is gained, as we thus produce a much less angle upon the mail cords or heddles, than by giving a more uniform strain upon the warp, which renders the loom applicable to broad work; also, by rendering each mail cord or heddle independent of every other mail cord, and capable of being transferred from any one harness shaft to any other harness shaft or bar, the operator is enabled to change the mounting or cording with greater facility than by the mode heretofore adopted.

"Our second is to be found in the peculiar means or manner of producing the rotary movement of the pattern prism."

Claim.—"What we claim is the improvement on the jacquard loom as herein described, to wit: the horizontal harness shafts or bars, of such length as may be desired, (according to the width of the cloth,) upon which the several mail cords or heddles, which constitute the harness or entire mounting, are distributed at any required distance from each other; together with their hooks, pins, loops, or holes, upon or in which the several mail cords or heddles, which are caused to be raised or operated upon by one needle, or distinct movement, are separately fastened or attached.

"We also claim the improvement for producing the rotation of the pattern prism; the same consisting in combining with the machinery that advances the pattern prism, other mechanism, which, at the same time, shall produce a movement of the draw pawl in an opposite direction as described."

57. For an *Improvement in Mills for Grinding;* Joseph N. Walker, Cincinnati, Ohio, December 24.

"The nature of my invention consists in constructing a portable mill with the shell of cast iron, and is arranged so as to keep the entire inside clear of dirt or dust, and at the same time have easy access to the machinery within."

Claim—"Having thus fully described my invention, what I claim therein as new is the combination of the hollow spindle A, feeding tube E, and adjustable screw *a*, with the gimbal *i*, when said gimbal is placed above the openings through which the grain or other material to be ground passes to the surfaces of the stones, as herein fully set forth and represented, for the purpose of having an uninterrupted feed through and past the gimbal."

---

58. For an *Improvement in Hot Air Furnaces;* George E. Waring, Stamford, Connecticut, December 24.

"The object of the first part of my invention is to distribute the heat equally over the radiating surface, and, with this view, consists in carrying the heat and products of combustion up to the top of the furnace, and then causing them to descend between a cylinder of tubes surrounding the fire-pot and the exterior casing of the furnace; the said tubes being connected together by short partitions, thereby forming an annular flue between them and the external casing of the furnace down which the heat and products of combustion descend.

"And the second part of my invention consists in the use of a distributer, which not only admits of the free circulation through it of the external air, but by means of arched passages or channels opening into the annular flue above mentioned, causes the heat and products of combustion (which have been brought down the said cylindrical flue) to enter the exit chamber which forms the base of the furnace, and back to the smoke pipe.

"And the third part of my invention consists in admitting the air to be warmed into a chamber warmed by radiation from the fire-pot, and from the descending current from the fire, and then causing the same to pass up through the body of the furnace, through a series of tubes arranged in the form of a cylinder, by the radiation of the heat from the fire-pot which they surround, and from the descending current which surrounds them."

Claim.—"What I claim as my invention, is the annular flue between the cylinder of tubes and the external casing of the furnace, for the purpose of distributing the heat equally over the external casing, substantially as described.

"I also claim the distributer, or annular distributing chamber, provided with arched passages for the purpose of carrying the heat and products of combustion to the exit chamber, and which also admit of the free circulation of the external air in and around the fire-pot, substantially in the manner and for the purpose described."

---

59. For an *Improvement in Machines for Weighing Grain;* Samuel R. Wilmot, Lafayette, Indiana, December 24.

"The nature of my invention consists in the peculiarity of the weighing beam; likewise the manner of arranging the gate so as to tilt the vibrating or weighing scale by the closing of said gate, which, on its return, strikes the gate-rod and raises it; also the manner of stopping the operation of the machine by means of a bolt or catch, thrown from the indicator at any given period."

Claim.—"What I claim as new, is the employment of the gate-rod *f*, connected to the sliding gate *e*, and weighing beam *d*, in combination with the said sliding gate, and weighing beam, constructed and operating as aforesaid, for opening and closing the gate, to admit the grain to the dish or scale, or exclude it therefrom at the required periods, by the ascent and descent of the dish or scale, during the operation of weighing and discharging the grain, as herein fully set forth.

"I also claim the manner of attaching the vibrating weighing scale *l* to the weighing beam *d*, so that the said weighing scale, as soon as the required quantity of grain shall have entered it, shall descend and close the gate, and bring the hammer-end, *j*, of the gate-rod against the lip of the dish or scale, and cause the scale to turn on its centre *m*, and immediately ascend and strike the gate-rod, and re-open the gate, and assume its former position for another weight of grain,—every operation of the weighing apparatus being indicated by an index of the ordinary construction affixed to the end of the scales—the said scale being arranged below a hopper of the ordinary construction.

"I likewise claim turning the short end of the weighing beam upwards, in the manner

represented in fig. 1, and placing the arms to which the bale of the scale is suspended on a line drawn through the fulcrum of the weighing beam, forming an angle of about 50° with a horizontal line passing through said fulcrum, for the purpose of increasing the leverage of the short arm of the beam, simultaneously with diminishing the leverage of the long arm as the scale or weighing dish descends, by which the gate is acted upon with increased speed and force, inclosing the same."

JANUARY.

1. For an *Improvement in Daguerreotype Pictures;* Charles J. Anthony, Pittsburg, Pennsylvania, January 1.

• • "And which improvements are applicable to all operations in which the agency of light can be employed to produce fac simile or representations of animate or inanimate objects, by acting on chemical substances placed on the surface of metal plates, or on or in any other fit material, properly prepared to receive the chemical substance or substances on which it is desired that the light shall operate to produce the intended effect."

Claim.—"What I claim as new and of my own invention, is the application of transparent or translucent materials of varying thicknesses and forms, separately or in combination with each other, and the application of substances or materials, more or less opaque, either separately or in combination with transparent or translucent materials, both or either when such applications and combinations are separately, consecutively, or conjointly employed, for the purpose of manipulating the action of light on chemical substances, substantially in the manner and with similar effects to those described and shown."

---

2. For *Improvements in Car Couplings;* Silas M. Cochran, Baltimore, Maryland, January 1.

"The effect to be attained by this invention is the disconnexion of such cars and locomotives as may be thrown, when in motion, from their places on the track, from those remaining upon it, and thereby rendering such accidents less dangerous to passengers, and preventing damage to cars, &c."

Claim.—"But what I do claim as my improvement is, in combination with the curved arms or ends $X^1 X^1$, of the jaws $X X$, the turning slotted bar L, attached to the casting T, (fig. 2,) having its ends, $L^1 L^1$, curved in such a manner as to act as levers, and the spring B, for keeping the slotted bar L, and jaws X, in their proper position; the disconnexion of the cars being effected by the contact of the curved arms or ends L^1 of the turning bar L with the draft beam P, when the preceding car runs off the track,—when either of the curved arms X^1 of the jaws will be relieved from the slot of the turning bar L, and permit the connecting bolt to pass therefrom."

---

3. For an *Improved Nozzle for Lead Pipe Machines;* John B. Collan, Reading, Pennsylvania, January 1.

"My machine is constructed to manufacture lead pipe, by pumping melted lead through a corrugated nozzle or die in which a mandril is supported, the nozzle and mandril being constructed in such manner that, in forming the pipe, the lead, in its passage through the tubular nozzle, is strongly compressed, thus forming pipe of increased density and freedom from flaws."

Claim.—"What I claim as my invention, is the corrugated nozzle with its mandril, through which melted lead is pumped for the purpose of making pipe, as herein set forth."

---

4. For an *Improvement in Planing Machines for Dressing the Edges of Boards;* Wm. E. Cornell, Boston, Massachusetts, January 1.

"The first part relates to the method of gearing the top and bottom feed rollers, so that they shall move together and remain in gear, to whatever extent they may be separated by varying thicknesses of planks; and this part of my invention consists in communicating motion from one roller to the other by means of a cog pinion on the arbor of each, connected by a cog wheel with an outer and inner range of cogs, the inner range engaging the cogs of the pinion on the arbor of the lower roller, and the outer range engaging the cogs of the pinion on the arbor of the upper roller; the arbor of the cog wheel being hung

and connected by a link or links with the arbor of the lower roller, and by another link or links with the arbor of the upper roller, so that as the rollers are drawn nearer together or separated, the cog wheel will, by reason of these links, vibrate between the two pinions, and remain in gear with them.

"The second part of my invention relates to the method of operating one of the cutter wheels, for either edging, or tonguing, or grooving the tapering edge of plank; and this part of my invention consists in operating the machinery which causes the cutter wheel gradually to approach towards, or recede from, the line of motion of the plank, by the passage of the plank over, and in contact with, one or more cogs or spur wheels, so that this motion shall be received from, and correspond with the motion of, the plank.

"And this part of my invention also consists in interposing, at some point in the gearing between the wheel or wheels operated by the plank, and the sliding frame or carriage which carries the cutter wheel, a reversing gear, for the purpose of setting the machine to work from the narrow towards the wide end, or from the wide towards the narrow end, and, if suspended, will edge the plank parallel to the other edge."

Claim.—"What I claim, therefore, as my invention, is the method substantially as described, communicating motion from the bottom to the top roller, by the two pinions combined with the wheel having the inner and outer rim of cogs, by means of the joint links, substantially as described, and for the purpose specified.

"I also claim operating the machinery for carrying the cutter wheel towards or from the line of motion of the plank, by the passage of the plank over, and in contact with, a spur wheel or wheels, substantially as described, whereby the motion of the cutter wheel, for edging tapering planks, will be made to correspond with the motion of the plank itself, as described.

"I also claim interposing between the wheel or wheels actuated by the plank and the carriage of the cutter wheel, a running motion substantially as described, by means of which the machine can be made to act on the plank from the narrow to the wide end, or *vice versa*, or, by suspending its operation, edge the plank with parallel sides, as described."

---

5. For an *Improvement in Water Metres;* John Ericsson, City of New York, January 1.

"The leading object of my invention is to measure the quantity of water which passes through the main and branch pipes for the supply of cities. It is, therefore, important that the said instrument should possess the combined properties of cheapness of construction, accuracy of measurement, simplicity, compactness, and durability."

Claim.—"What I claim as my invention, is connecting the two pistons with the two cranks of a crank shaft, in manner substantially as described, so that at the end of each stroke of either of the pistons it shall remain at rest while the crank shaft is being impelled by the other piston, so that the valves shall be shifted whilst the piston is at rest, for the purpose substantially as described.

"I also claim, in an instrument for the purpose herein specified, determining the range of motion of the piston, by means of stops connected with the cylinders and the pistons, substantially as described, in combination with the connexion of the pistons with the crank or cranks, by means of a joint having sufficient play to permit the pistons alternately to remain at rest while the crank shaft continues to rotate, substantially as described."

"I also claim enclosing all the moving parts of an instrument substantially such as above described in the surrounding casing, through which the water or other fluid passes to be measured, constructed and operating in the manner and for the purpose substantially as described."

---

6. For an *Improvement in Churns;* Daniel Fisher, College Corner, Ohio, January 1.

"The nature of my improvements consists in having a horizontal cylinder or tube, connecting a double dasher churn, which is provided at each end with perforated plates or cutters. This tube or cylinder serves as a receptacle and condenser of air; the perforated cutters answer the double purpose of cutting the cream in its passage to and fro, and only allowing sufficient cream to enter through the perforations, at each stroke of the dashers, to keep the tube half full or thereabouts, thereby creating a partial vacuum in the tube, which becomes filled with air. When a rapid commotion is produced in the cream by the action of the dashers, the air in the tube is forced to mingle with the cream, and find its way out through the opposite end of the tube, and from thence up through the cream in the churn."

Claim.—"What I claim therein as new, is connecting two vertical churns by a hori-

zontal tube at their bottoms, substantially as described, (said tube being about ten inches long, and about one-fifth of the capacity of one of the vertical cylinders,) in combination with the perforated cutters E E, operating in the manner and for the purpose herein fully set forth."

---

7. For a *Method of Connecting the Slide Valve with the Rock Shaft;* Samuel H. Gilman, Cincinnati, Ohio, January 1.

Claim.—"Having thus fully described the nature and construction of my improvements in oscillating steam engines, what I claim therein as new is the tubular vent, (13,) serving the two-fold purpose of a guiding rod, and of a clamp for the ball joint at the foot of the valve pitman."

---

8. For an *Improvement in Machines for Assorting Broom Corn;* Lorenzo D. Grosvenor, Harvard, Massachusetts, January 1.

"I would remark that I do not intend to confine my machine to the work of sorting sprigs of broom corn for the manufacture of house brooms, as it may probably be adapted to the assorting of various other matters, such as bristles for brushes, feathers for dusters, &c."

Claim.—"What I claim as my invention, is the combination of the endless platform, the roller G, and the series of pressure rollers, or any mechanical equivalents therefor, as arranged and made to operate together, substantially in the manner and for the purpose as herein before described; and in combination therewith, I claim the rotary shears and the weighted roller *m'*, or their mechanical equivalents; the whole being applied and made to operate together essentially as herein before specified."

---

9. For an *Improvement in Quilting Frames and Apparatus;* Abraham Kaufman, Orrstown, Pennsylvania, January 1.

Claim.—"What I claim as my invention, is the movable frame, working on the connecting piece O, connecting two slides with wickers, for the purpose of stretching the quilt to any desirable length or breadth, as the case may be, in combination with the slides No. 1 and 2, working in sections C C, by which the quilt may be enlarged or diminished, and the rollers No. 1 and 2, as set forth."

---

10. For an *Improvement in Spring Carriage Wheels;* John Lamb and Charles H. Root, McDonough, New York, January 1.

"The nature of our invention consists in the use of curved flat steel spokes, secured to the rim of the wheel at two points of each spoke, and resting on the hub or nave, through slots in the edge of the hub, with grooves or notches at their extremities overlapping an annular projection in the hub, and further secured by the axle box, which has grooves into which the ends of the spokes fit and butt up against the axle box, being secured to the hub by bolts and projections on the edge of the plate covering the hub, which fits into the slots formed for the spokes, and serving to keep the spokes in their places."

Claim.—"What we claim as our invention, is the construction of the spokes B B B B B B B B, of flat steel, split or divided, and curved as at *a a*, and secured as at *b b*, fig. 1, for the purpose and in the manner herein shown."

---

11. For an *Improvement in Candlesticks;* James Manning, Middletown, Connecticut, January 1.

"The nature of my invention consists in attaching an eccentric flanch to the upper part of the tube of the candlestick, said flanch having a circular cap which turns upon its upper surface, and is kept in its proper position by means of clasps or lips which set over the edge of the flanch. There is a circular orifice through the cap, eccentric with its periphery, and corresponding in size with the diameter of the bore of the tube. When the cap is placed in such a position as that its orifice is directly over the bore of the tube, a candle of the same diameter as the bore of the tube is admitted; but when the cap is turned from this position, its orifice being eccentric with its periphery, a portion of the tube is covered by the cap and its aperture consequently contracted. By this means candles of a less

diameter than the bore of the tube are held firmly in it. There is a guard attached to the cap which passes a short distance over the tube, to prevent the candle being cut by the edge of the orifice of the cap."

"*Claim.*—"What I claim as new, is the combination of the flanch B with the circular cap C, having its orifice E eccentric with its periphery, and a guard G, operating in the manner and for the purpose as above described."

---

12. For *Improvements in Looms for Weaving Seamless Bags;* Shelden Northrop, New Milford, Connecticut, January 1.

"The loom, as improved by me, is for the purpose of weaving seamless bags, by weaving the cloth double and united at one or both selvages for a given distance, to form the bag, and then, at given distances apart, weaving the cloth single, to unite the two cloths; and to this end, my invention consists in arranging and combining two series of cams, one series to work the warps so as to weave two cloths either united at one or at both selvages, and the other to interlock or interweave all the warps to make a single cloth, when this is combined with a shifting apparatus to connect, at pleasure, either series of cams with the treddles that operate the harness."

Claim.—"What I claim as my invention, is the arrangement in one loom of the two series of cams, substantially as described, one series for weaving the cloth double, and the other single, as herein described, in combination with the shifting the treddles from one series of cams to the other, or the equivalent thereof, substantially as herein described."

---

13. For an *Improvement in Seed Planters;* James P. Ross, Lewisburgh, Pennsylvania, January 1.

"My improvement consists, 1st, in the drum by which the drill teeth are raised or lowered, at the same time the feed gear is thrown in or out of gear. 2d, In the mode of constructing the feed gear, so that it can be changed to sow different qualities of seed to the acre. And 3d, in the manner of attaching the hollow drill teeth to their drag bars, so that, when coming in contact with any unyielding obstruction, they become wholly detached from the machine."

Claim.—"What I claim as new therein, is, 1st, the pinion *k*, working between fixed and movable racks, in combination with the elevating yoke *c*, and the loop *f* on its end, for the purpose of raising the teeth from the ground, and simultaneously throwing the feeding apparatus out of gear, substantially as set forth.

"2d, I claim the feeding gear, as described, in combination with the lever *g*, and its adjustable fulcrum, permitting the pinions to be reversed, by which double the number of changes can be made as can be done by the same number of pinions on the ordinary arrangement."

---

14. For an *Improvement in Printing Presses;* Stephen P. Ruggles, Boston, Massachusetts, January 1.

Claim.—"What I claim as my invention, is the gauge bar for cards herein above referred to, in combination with the vibrating platen and stop finger, and crank which operates the same, in the manner and for the purpose herein above described.

"I also claim the use of a segment of a cylinder, in combination with the stationary form bed, so that the rotary inking apparatus may move over the form, and then, after taking ink from the fountain, distribute it on said cylinder, as herein above set forth.

"I also claim the movable bearers on the side of the form bed, arranged and operated substantially as above described, so as to be moved outwards when the inking rollers are passing over the form, and drawn inwards when the sheet or tympan is moved up to said form.

"I also claim regulating the delivery of the ink, by combining with the delivering roller a grooved ratchet wheel and weighted pawl band, operating with the lever stud, cam roller, and stop lever, substantially as herein above specified.

"I also claim supporting the journals of one of the inking rollers on sliding bearers, so that it may be moved up against the delivering roller by means of studs on said bearers, and cams operating the same, as herein above set forth."

15. For an *Improvement in Machines for Turning Irregular Forms;* Jonathan Russell, Philadelphia, Pennsylvania, January 1.

"The nature of my improvement consists in cutting spokes, &c., or any other irregular forms, to pattern, while the pattern and rough material are held fast and do not revolve. The pattern and rough material are both held fast in a carriage or carriages placed in the same line, or one above the other, which have a right and left longitudinal motion, and an up and down motion, along and by the cutting tools and tracers, or friction points. There are two carriages which have a lateral motion towards and from each other; in or on these two carriages are placed the tracers and the cutting tools. The tools and tracers work against and over the pattern and rough material, while the pattern and rough material move to the right and left along and by the cutting tools and the tracers, and up and down after they have reached the end of the pattern and rough material, or *vice versa*, the friction points following the shape of the pattern, so that the rough material may be cut like the pattern. The tracers are made to set out or in, so that the rough material may be cut larger or smaller, on one or both sides, than the pattern."

Claim.—"What I claim as my invention, is the combination and arrangement of the horizontal carriages G G, working inside of, and moving vertically with, the carriage F, and operating as herein described, for the purpose of making the pattern and rough material pass and repass the tracers and cutting tools, or *vice versa*, when the same are used in combination with a pattern and rough block which do not revolve, and are presented to, and operated upon by, said tracers and cutters, as herein described and represented, and for the purposes fully set forth."

---

16. For an *Improvement in the Manufacture of India Rubber;* Jonathan T. Trotter, City of New York, January 1.

"The nature of my invention consists in the new and useful manner in which I prepare the rubber by means of an article or preparation of zinc."

Claim.—"Having described my improved process for curing rubber, what I claim is the use and employment of zinc, substantially as prepared by the process above described, in combination with India rubber, for the purpose of curing or vulcanizing it, in form and manner as herein set forth, without the use of free sulphur in any way in combination with the rubber."

---

17. For an *Improvement in Corn Shellers;* Joshua M. C. Armsby, Worcester, Massachusetts, January 7.

Claim.—"What I claim as my invention, is casting the fly-wheel of the corn sheller solid with the feeding wheel, so as to bring it between the two bearings of said wheel, as herein before set forth."

---

18. For an *Improvement in Spring Mattresses for Invalids;* David Baird, City of New York, January 7; anté dated October 1, 1850.

"The advantages of elevating spring mattresses to all, and more particularly to invalids, have been universally acknowledged, but as they have hitherto been constructed they have been imperfect, and subject to give rise to many inconveniences which have retarded their introduction to common use. Among these objections were the awkward modes of changing the position, the liability to get out of order, the unavoidable entrance of vermin into the interior, and the impossibility of effecting their expulsion when once they had taken possession.

"My improvements consist in making the chamber which contains the springs, &c., so that all its parts shall be hermetically sealed against the entrance of vermin, and have none of its interior parts projecting through the case."

Claim.—"What I claim is, 1st, the employment of the end stays *b*, having rule joints, allowing a limited range of motion, and standing in a bracing position, substantially in the manner and for the purposes set forth.

"2d, I claim the centre supports for rendering that part of the mattress permanent when desired."

19. For an *Improvement in Rotary Pumps;* Thomas Bennet, City of New York, January 7.

"The nature of my invention consists in combining with the rotating fan or paddle wheel, the annular space provided with curved water-ways, which answer the purpose of guides for the upward flow of the water."

Claim.—"What I claim as my invention, is the arrangement of the curved water-ways in the annular space above the fan or paddle, when in combination with the rotating fan or paddle wheel, substantially as described, and for the purpose specified.

"And I also claim the self-adapting valves substantially as described, and governing the apertures leading to the annular space above, in combination with the rotating fan or paddle wheels, and the curved water-ways, substantially in the manner and for the purpose specified."

---

20. For an *Improvement in Looms for Weaving Tapestry Carpets with Parti-Colored Warps;* Erastus B. Bigelow, Clintonville, Massachusetts, January 7.

"The first part of my invention consists in regulating the delivery or giving out of one or more separate warps or chains, by the separate tension of each warp, in combination with a ground or controlling warp, which determines the length of cloth made at each beat of the lathe, the delivery of said ground or controlling warp being also regulated by its tension, and controlled or fixed by a break, when the lathe beats up the cloth; the whole being combined with a regular and positive take-up motion for taking up the finished cloth, whereby the figures of the cloth may be of a regular measured length, and the body of the cloth, as nearly as practicable, of regular texture, as described.

"The second part of my invention consists in the employment of an index measuring apparatus, or the equivalent thereof, to indicate the amount of figuring warps which are taken up in the process of weaving, that the tension thereof may be varied, if more or less than sufficient is being woven in, when this is combined with an index measuring apparatus, or the equivalent thereof, to indicate the amount of cloth woven, whereby the figure on the warps and on the woven cloth can be relatively measured, to determine the entire figure, whilst the delivery of the figuring warps is self-adapting to any slight inequality in the warps, or formation of the loops.

"And the last part of my invention consists in the employment of grids or fingers, vibrating independent of the lathe, for drawing forward and giving tension to the weft, before the lathe completes its beating up movement; and also to retain the weft, whilst the lathe commences its back movement, to prevent such back movement of the lathe from drawing back the filling or weft."

Claim.—"What I claim as my invention, is regulating the delivery or giving out of one or more warps or chains by the separate tension of each, substantially as specified, in combination with a ground or controlling warp, which determines the length of cloth made at each beat of the lathe, by having the delivery of the said ground or controlling warp regulated by its tension, and controlled by a break, or the equivalent thereof, when the lathe beats up, substantially as specified.

"I also claim the employment of an index wheel or measuring apparatus, or the equivalent thereof, to indicate the length of figuring warps given out or taken up in the process of weaving, substantially as and for the purpose specified, when this is combined with an index or measuring apparatus to indicate the amount of cloth woven, substantially as and for the purpose specified.

"And lastly, I claim the employment of fingers, moving or vibrating independently of the lathe, substantially as and for the purpose specified."

---

21. For an *Improvement in Fountain Inkstands;* Francis Draper, East Cambridge, Massachusetts, January 7.

"By my improvements I shut off the main portion of the ink in the fountain from that in the tube, by having the tube, through which the ink is flowed or pressed into the cup, extended down (sometimes through a cylinder and sometimes not) to the bottom of the inkstand, and having a piece of cork or other similar substance fitted on its end, which bears against a similar piece of cork fitted in the bottom of the inkstand, and by screwing the tube (and cylinder when it is used) down, so as to have the cylinder or cork on the end of the tube pressed against the cork in the bottom of the fountain, the main body of ink in the fountain is entirely cut off from that in the tube."

Claim.—"What I claim as my invention, is the arrangement for cutting off the communication between the cup and the main fountain of ink, by means of a layer of cork, or other similar substance, in the bottom of said fountain, and a cork or other similar stopper fitted on the bottom of the cup tube, or the lower end of said extended cup tube pressing against said layer as set forth; and, in combination with the above specified arrangement, the inner cylinder in which said stopper moves as a piston, by which the air is more effectually excluded from the main fountain of ink."

---

22. For an *Improvement in Machines for Jointing Staves;* William Maguire, Cincinnati, Ohio, January 7.

"My invention consists in apparatus for jointing the staves."

Claim.—"What I claim therein as new and original, is the arrangement substantially as herein described, of a circular rest, having a sliding motion to and fro in the plane of its axis, and having around its perimeter catches for the retention of the stave during the process of jointing, and rotating the distance from stave to stave at every forward stroke, and held fast for the action of the rotating jointers upon the stave at every return stroke, the jointers and circular rest being so arranged as to impart at the same time to the stave edge any given bevel and taper, according to the size and bilge of the cask."

---

23. For an *Improved Fly-Tumbler Lock for Fire-arms;* Stanhope W. Marston, City of New York, January 7.

Claim.—"What I claim as my invention, is the fly-tumbler, arranged and combined, with respect to the sear and the cock, in the manner and for the purposes set forth in my specification."

---

24. For an *Improvement in Grass Harvesters;* Edward Neely, Savannah, Missouri, January 7.

"My object in securing and suspending the different parts of my machine by straps, chains, and yielding joints, is to allow the parts to yield, when the machine is stopped by accident or other cause. In machines geared tight, when suddenly stopped, the bevel gear is often broken. In my invention this is entirely avoided, by allowing the different parts some motion or play, after the driving apparatus has stopped."

Claim.—"What I claim as new, is the manner herein described of suspending the cutter ring *h*, from the wheel *f*, by means of straps or other yielding material, for the purpose herein described.

"I also claim the combination of the cutters *i i i*, &c., beveled cutter ring *h*, and straps *g g*, &c., for the purpose of raising the cutter ring over any obstruction coming against the edge of the knife, as herein described.

"I also claim the manner of arranging the guide board *m*, standard *n*, arm *o*, and strap *r*, secured as described, for the purpose of guiding the machine, and allowing the parts to yield to a sudden stopping of the machine, or to irregularities in the ground, for the purpose and in the manner described."

---

25. For an *Improvement in Electro-Magnetic Engines;* Jacob Neff, Philadelphia, Pennsylvania, January 7.

"In order to control the power of the engine, I propose to attach a governor to it, which shall act upon a lever, which shall be connected to the negative plate or plates of the batteries, by which means the amount of electricity can be regulated."

Claim.—"What I claim as my invention is the insulated disks, in combination with the platina points, to act in concert with the magnetic wheels, in manner and form, and for the purposes herein described."

---

26. For an *Improved Arrangement of Arches in Bridge Trusses;* Cunningham M. Pennington, Rome, Georgia, January 7; antè dated December 9, 1850.

"The nature of my invention, consists in a certain combination and arrangement of upright and inverted arches, by which all thrust against the abutments or piers is prevented, and at the same time securing a permanent structure."

Claim.—"Having thus fully described my invention, what I claim therein as new is the

method herein described of combining and arranging the several arches of a bridge so as to make each arch, alternately, the upright and inverted arch, as it passes from one span of the bridge to the other, and *vice versa*, when one set of said arches have their remotest distance from each other, and their greatest sustaining points directly over and under the points, when the other set of arches are changing from upright or inverted arches, or *vice versa*."

---

27. For an *Improvement in Coal Stoves;* James Shields, City of New York, and Samuel Pierce, Troy, New York, January 7.

"Our invention is of an improvement in the downward draft stove invented by Dr. Eliphalet Nott, in which the charge of coal is contained in a fire chamber extending above the aperture for the draft, leading to the flues through which the products of combustion circulate, to heat a large amount of metal surface for the radiation of heat."

Claim.—"What we claim as our invention, is the method substantially as herein described, of supplying currents of atmospheric air to the products of combustion, at or near the throat leading from the fire chamber to the flue, in combination with what is known as Nott's fire chamber, having the draft throat leading therefrom between the top and the grate, that the upper part of the fire-pot may constitute a feeder or chamber of preparation, substantially in the manner and for the purpose specified."

---

28. For an *Improved Parallel Vise;* Samuel R. Simpson, Springfield, Ohio, January 7.

"The utility of this combination is to obviate the frequent adjustments of the vise-jaw to the ever-varying thickness of lumber and other materials which are to be worked in a vise."

Claim.—"What I claim as my invention, is the attaching the lower end of the moving jaw of the vise to a block that is attached to, and moves with, the end of the screw, in the manner and for the purposes herein described."

---

29. For an *Improvement in Ox Yokes;* Andrew L. Simpson, Durham, New Hampshire, January 7.

"The great object of my improvement, the device to secure which constitutes the distinguishing feature of my invention, consists in relieving the weaker ox, where there is a difference in the strength of the two, by having two staples some six inches apart, in lieu of one staple, to one of which staples the draft chain is fastened, while to the other staple a branch chain, some sixteen inches long, is connected by a hook, its other end being connected to the main draft chain. The effect of this is, that when the stronger pulls more than the weaker one, he instantly straightens the main draft chain, and slackens the branch chain, so that the strength of the weaker ox then acts with a lever six inches longer than when both chains are tightly drawn. This is a great desideratum."

Claim.—"What I claim as my invention, is arranging in the beam of the yoke two draft staples, some six inches apart, in lieu of one at the centre, and the combination or use therewith of a branch chain of proper length, connected to the main draft chain at a proper distance from the beam, and the adjustable hook for modifying the length of the branch chain, as herein above specified and for the purpose set forth."

---

30. For an *Improved Means for Revolving the Breeches of Repeating Fire Arms;* James Warner, Springfield, Massachusetts, January 7.

"The nature of my invention consists in such construction of a revolving chambered pistol that the chambers will be caused to revolve by the action a lever, of which the fulcrum or axis of vibration is in line, or nearly so, with the axis of rotation of the chamber; whereby I am enabled to effect the revolution of the chambers with greater certainty, and, by simplifying the construction, to diminish the cost of manufacture, as well as the liability to derangement in rapid action."

Claim.—"What I claim as of my own invention, is the cranked shaft *e c b*, operated by the tumbler, having its axis of vibration in the line, or nearly so, with the axis of rotation of the cylinder, substantially in the manner herein set forth."

31. For an *Improvement in the Manufacture of Caviar;* Robert G. Westacott, Worcester, assignor to Robert G. Westacott, Ephraim Lombard, and Nathaniel K. Lombard, Boston, Massachusetts, January 7.

"The experiments I have made have enabled me to produce an improved manufacture of the article in question, which not only enables me to transport it to warm latitudes, and there keep it for a great length of time in a perfect state of preservation, but at the same time to prevent its induration in a great degree, if not entirely, and impart to it a flavor that renders it extremely palatable to those who eat it."

Claim.—"What I claim, therefore, as my invention, is the improvement in the process of salting the roe or ova, whereby extraneous matters are separated, the same consisting in suffering it to stand in pickle, or a strong saline solution, until it undergoes a process or change, by which the ova and such extraneous matters separate from one another, the former rising to the surface of the pickle, while the latter falls to the bottom of it.

"And I also claim the combination of the male sturgeon oil, as above mentioned, with the salted ova, for the purpose of improving the manufacture thereof as specified."

MECHANICS, PHYSICS, AND CHEMISTRY.

Description of a New Arrangement of Reflecting Telescope, by which much comfort and convenience is secured to the Observer. By James Nasmyth.*

[Paper read at the Meeting of the British Association, Edinburgh.]

The optical department of this arrangement is seen in section in fig. 1, where it will be observed that by the union of the Newtonian and Cassegrain construction, in so far as respects the turning back of the cone of rays by the small convex mirror, C, and receiving them at D, by a small diagonal plane mirror, D, the rays which ultimately form the image of the object are sent out sideways through the *trunnion*, G, in which the eye-piece is placed, and through which, in fact, the observer views the object.

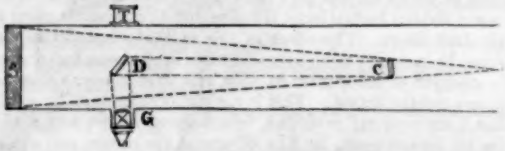


Fig. 1.

By having a corresponding trunnion at the opposite side, T, and employing these trunnions as the supports of the telescope, and using them as the axis on which it is moved in altitude, it will be evident that, as the eye-piece, G, is thus *in the centre of motion*, whatever be the sweep of elevation in moving the telescope vertically from object to object, no change in the position of the eye of the observer will be required; his eye, while opposite to the trunnion, *is common* to all positions of the instrument in altitude; his eye is virtually in the centre of motion.

But as the telescope has to be moved round so as to follow the motion of an object in azimuth, it is desirable that the observer should not have to change his position even in this respect. Therefore, in order that he may sit at his ease opposite to the eye-piece while the telescope is moved either in altitude or in azimuth, all that has to be done to attain this object

* From the London Architect, for November, 1850.

is to *place the entire instrument on a turn-table*, and have a comfortable seat for the observer also on the turn-table, and then, whatever be the elevation or direction in which the telescope is pointed, the observer need never stir from his comfortable seat; and as we all know with what ease ponderous machines, such as railway wagons or locomotive engines, can be swung round on properly constructed turn-tables, and also the ease with which a well-balanced mass can be swung when it centres, some idea may be formed of the perfect ease and facility with which such an instrument as this of Mr. Nasmyth's can be governed and directed by the observer, who has, by means of suitable hands brought close to his chair, the most perfect command of every requisite movement.

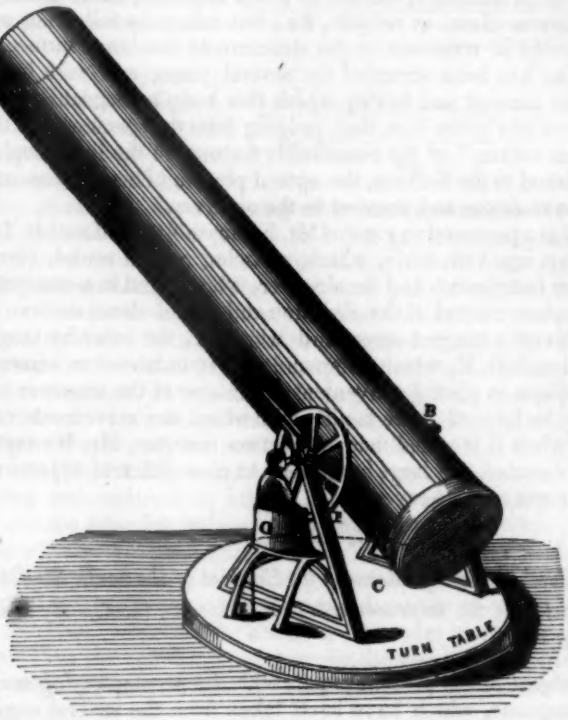


Fig. 2.

The instrument in question which is represented in fig. 2, weighs upwards of two tons, can be moved in every direction by the point of the finger, swung round in an instant, or elevated to any object on a slow motion given to it, so as to enable the observer to keep the object in the centre of the field for hours. Such is the perfect steadiness of the motion, that not the slightest tremor is perceptible, even when observing with a magnifying power of 450 times. Some objection may be urged against the optical arrangement by which Mr. Nasmyth has brought his telescope to yield this central vision, in so far that it is requisite to employ a *third*

reflecting surface, namely, the small plane diagonal mirror (D, fig. 1,) by means of which we are enabled to view the object through the hollow trunnion G, fig. 1, or B, fig. 2; no doubt, some portion of light is sacrificed by the employment of this third reflector; but when we obtain in exchange so vast an amount of convenience and comfort as result from the adoption of this arrangement of Mr. Nasmyth, most observers will be happy to accept the exchange, and with the advantage of the ease, comfort, and tranquility resulting from the absence of all personal sources of interruption, Mr. Nasmyth presumes that by thus inducing more frequent and careful observations, science will be advanced.

Mr. Nasmyth stated, that the main object he had in view in constructing this large telescope, was not so much to pursue observations of objects of the fainter class, as nebulæ, &c., but rather for following up series of observations in reference to the structure of the lunar surface, on which subject he has been occupied for several years; and such has been the increased comfort and facility which this truly manageable and powerful instrument has given him, that, judging from the specimens of the "drawings from nature," of the remarkable features of the lunar surface, which he exhibited to the Section, the optical powers of his instrument are equal to its convenience and comfort to the observer.

Fig. 2 is a perspective view of Mr. Nasmyth's "Comfortable Telescope;" C is a cast iron turn-table, which, on being moved round, carries with it the entire instrument, and the observer, who, seated in a comfortable chair, has complete control of the elevation and round-about motion; the former by means of a tangent screw and wheel, F, the latter by tangent screw and pinionshaft, E, which commands the roundabout or azimuth motion. An eye-piece is placed convenient to the eye of the observer at G. Some idea may be formed of the facility with which the movements can be controlled, when it is stated that within two minutes, Mr. Nasmyth has frequently directed this large instrument to nine different objects situated in various parts of the heavens.

On the Condensation of Steam in the Engines of the South Staffordshire Iron District, and the Improvements to be effected in them. By Mr. William Smith.*

The object of the present paper, with the accompanying series of indicator diagrams, which have been taken from the several engines by the author of the paper, is to show the present working condition of forty-eight of the largest class of mill, forge, and blast engines in South Staffordshire, with some remarks as to the practicability of improving them.

The general character of the indicator diagrams of the majority of these engines, shows a considerable pressure of steam, continued nearly uniform throughout the whole stroke of the piston, and averaging about 12 lbs. per square inch above the atmosphere in the forge and mill engines, and about 7 lbs. per square inch in the blast engines; with a very defective vacuum, commencing about the atmospheric line, and reaching only from

* From the London Artizan, October, 1850.

7 lbs. to 11 lbs. per square inch below the atmosphere at the end of the stroke, the average vacuum being about 6½ lbs. per square inch below the atmosphere throughout the stroke. Some of the indicator diagrams from blast engines show a considerable expansive action, but not a good vacuum.

Fig. 1shows the indicator diagram from a mill engine of 42 inch cylinder and seven feet stroke, making 17 strokes per minute, which was working very imperfectly in the condensation of the steam, and has been improved to a remarkable extent, by an alteration made for the purpose of improving the vacuum, which has effected a very considerable saving in the consumption of fuel. This engine was working with 19½ lbs. pressure of steam at the beginning of the stroke, continued to 17½ lbs. pressure at the middle, and reduced to 6 lbs. per inch at the end of the stroke, by wire-drawing the steam without any cut-off expansion valve; the average pressure being 16·37 lbs. per square inch throughout the stroke, the average vacuum was only 2·72lbs. per square inch below the atmosphere, beginning a little above the atmospheric line, and reaching only 5 lbs. below the atmosphere at the end of the stroke. This performance being so bad it was considered necessary to examine the engine, and the cause was found to be from the valves, thoroughfares, and condenser being much too small for the proper proportion, the steam and eduction valves being only 7 inches diameter, and the thoroughfares of the same size; these were therefore removed and replaced by others, the steam valves being 10 inches diameter, and the eduction valves and thoroughfares 12 inches diameter, or three times the area of the original ones. The condenser was also nearly doubled in capacity by attaching a large vessel on the top of it, which made it rather larger than the regular proportion; the air pump was only 24 inches diameter, with half the stroke of the steam piston, or about ⅛th less contents than the regular proportion for the size of the cylinder; this was not altered, but there was an abundant supply of cold water for injection.

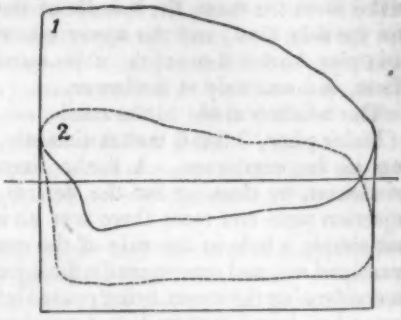


Fig. 1.

The result of the above alteration is shown in fig. 2, the steam pressure being 8 lbs. at the beginning, and reduced to about the atmosphere at the end of the stroke, the average being 5·40 lbs. instead of 16·37 lbs. per square inch pressure throughout the stroke; the vacuum commenced at 10½ lbs. and ended at 11 lbs., the average being 10·15 lbs. instead of 2·72 lbs. per square inch below the atmosphere throughout the stroke. The improvement in the vacuum amounts therefore to a constant average pressure of 7·43 lbs. per square inch throughout the stroke; the total power of the engine, as shown by the first diagram, was 19·09 lbs. per inch on the piston throughout the stroke, being 190 horse-power; consequently this improvement of the vacuum amounted to 39 per cent. of the total power of the engine, or 74 horse power.

The engine before the alteration had the steam valves, the eduction valves, and the thoroughfares only 7 inches diameter. By the alteration, the steam valves were increased to 10 inches diameter, and the eduction valves E and thoroughfares T to 12 inches diameter; the new valves being so much larger than the old ones, a different arrangement was required to make room for them, the spindle of the lower steam valve being carried up the side pipe, and the upper eduction valve placed over the other side pipe, so that three of the valve spindles are worked at the upper steam chest, and one only at the lower.

The addition made to the condenser, was a circular vessel constructed of boiler plate, 3 feet 6 inches diameter, and 15 inches high, fixed on the top of the condenser. A further improvement was also made in the condenser, by cleaning out the deposit of lime, and adding an internal injection pipe and rose; there was no internal injection pipe previously, but simply a hole in the side of the condenser, where the injection cock was fixed on, and consequently the injection water was much less efficient in condensing the steam, being poured into the condenser in a single stream, instead of being scattered in a number of small jets from the rose end of the pipe.

The majority of engines in this district are similar in this respect, and the reason that has been given, is, that the rose is apt to get the holes choked up by deposit from the water, which is very much impregnated with lime. This is a matter requiring particular attention in this district, and cases have come under the writer's observation, where condensers were filled up by the deposit in the course of two or three years' time, to such an extent, that the capacity was reduced fully one-half, as well as the passage through the foot valve; it is a very hard calcareous deposit, which adheres firmly to the cast iron, and requires considerable labour to cut it out, involving a serious stoppage of the engines, and they were consequently worked as long as possible before taking off the condenser cover to cut out the deposit, which increased to 7 inches thickness, and as much as half a ton weight in one engine.

Besides the very important saving effected by the greater power obtained from the steam, in consequence of the improvement of 39 per cent. in the vacuum, as described above, the engine has been found to do the work more regularly and satisfactorily since the alteration than before; it was liable to be pulled up by any extra strain of the rolls, &c., whenever the piston was getting in want of repacking, the leakage of steam injuring the vacuum on account of the very deficient condensing power; but that has not occurred since the alteration was made.

The engine drives a merchant mill of 3 pair of rolls, a guide mill of 3 pair, 2 pair of forge rolls, a forge hammer, 2 shears, and a pump for draining the foundations. It was not stopped longer than three days to make the whole of the alterations described above.

Another similar engine of the same size as the preceding, (No. 17) was also examined, in consequence of the imperfection in its condensing, and the valves and thoroughfares were found to be 10 inches diameter, but the valves had not sufficient lift; the eduction pipe to the condenser was 9 inches diameter, and the condenser was 2 feet 4 inches diameter, and 4 feet 6 inches high; the eduction pipe was then removed and replaced

with one 12 inches diameter, also a large vessel was fixed on the top of the condenser, which increased its capacity about one-third. The lift of the valves was then increased from $1\frac{1}{8}$ inch to $2\frac{3}{8}$ inches, and the result of the alteration was an improvement in the vacuum of from 1·50 lbs. to 7·97 lbs. per square inch below the atmosphere, or 6·47 lbs. per square inch increase of average pressure throughout the stroke.

The saving of fuel from these alterations has not been well ascertained, as the engines in both cases are worked from a series of boilers which also supply steam to other engines, upon which the load is very unequal; but the saving is admitted to be very considerable, and in the case of No. 17, the proprietors have been enabled to use an inferior description of slack, and also to throw off one boiler, with a fire grate about 7 feet square, and 45 square yards of heated surface, without any diminution in the power employed.

The aggregate power of the 45 mill, forge, and blast engines from which the indicator diagrams are taken, is nominally 3240 horse power, according to Boulton and Watt's proportions of the cylinders, but by the calculation of the indicator diagrams, the total is 7819 horse power; the average vacuum obtained in the present working of all the engines, is about 6 lbs. per inch below the atmosphere throughout the stroke, omitting from the average four, which are exceptions to the general run of these engines; and the average vacuum obtained in the 6 expansive engines, of which indicator diagrams are also given, is $10\frac{1}{2}$ lbs. per inch below the atmosphere throughout the stroke. The loss of power from the imperfect vacuum in the former engines may therefore be taken at the difference between these pressures, or $4\frac{1}{2}$ lbs. per square inch pressure throughout the stroke, which amounts to 1930 indicated horse power upon those engines; or in other words, an additional power of 1930 horse power, or 25 per cent. increased power might be obtained from the same expenditure of steam, and consequently of fuel, if the vacuum were improved so as to be as good as the average of the 6 expansive engines, or $10\frac{1}{2}$ lbs. per inch throughout the stroke. This vacuum has been obtained in the two engines, Nos. 12 and 17, which have been altered as before described, although in these engines the alteration was carried out only to a limited extent, and at a comparatively trifling expense; but if it were carried out efficiently by attaching expansive gear in addition to the alterations that have been made, a much better effect would be obtained by using the same volume of steam expansively.

In many cases the expansive action is accomplished by the addition of a separate expansion valve in the steam pipe, which is worked by a cam, so as to cut off the steam at any portion of the stroke that may be desired, this valve opening and shutting twice for each double stroke of the engine; the steam and eduction valves are worked by a common eccentric motion, the top and bottom valves opening and shutting together. But this is an imperfect mode of obtaining expansion, because the steam filling the side pipe and the two steam chests expands after the cut off valve is shut, and this steam forms a considerable proportion to the contents of the cylinder.

The only efficient mode of applying expansive action, is by lifting each valve by a separate cam, so adjusted as to shut each steam valve at

whatever point of the stroke may be desired, whilst the eduction valve is held open till the termination of the stroke; by which means the full effect of the expansive action is obtained. The difference in effect between these two modes of cutting off the steam, is shown by the diagrams Nos. 3 and 4, which are taken from a pair of blast engines working coupled together, and with no difference between them, except that in No. 4 the steam is cut off by a separate expansion valve in the steam pipe, and in No. 3 the valves are lifted by separate cams.

But independent of the loss sustained by not working expansively, the loss of power in the engines described being 1930 horse power as shown before, the annual loss in money by extra consumption of fuel in these engines, calculating 20 lbs. of slack per hour, for one horse power, at a cost of 3*s*. per ton, will amount to £18,610, or £2. 7s. 7d. per horse power per annum.

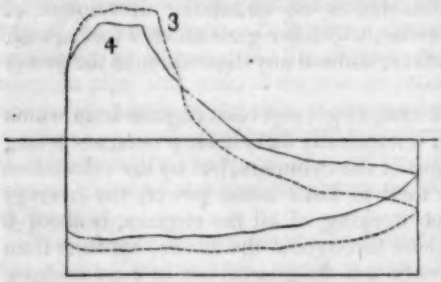


Fig. 2.

The total power of the steam engines employed in the manufacture of iron in this district, may be computed to be fully ten times the nominal power above named; and the total annual loss to the proprietor from the causes described in the present paper, may be therefore taken in round numbers at 180,000*l*, per annum, as the more expansive engines described above may be considered a fair average of the engines in the district.

It has been generally considered hitherto, that the improvement of expansive action of steam was not applicable advantageously to the engines of this district, because of the small cost of the fuel employed; but this will be seen to be an erroneous conclusion from the actual results of the alterations described above, where the improvement was only effected in the vacuum, and the expansive principle was not carried out, which would have effected a still greater saving. The total quantity of fuel consumed at present is so large, that although the price per ton is insignificant, the total amount of saving effected by the per centage on the whole is very important.

In addition to the saving in cost of fuel consumed, a very important saving would also be effected in the tear and wear of the boilers, which is fully in proportion to the extra fuel burnt under them, and the repairing of which is invariably attended with serious inconvenience and expense.

The description of boilers in general use in the district, and the further saving to be effected by improvements in their construction and mode of setting, is also an important practical subject for consideration, and it is intended to form the subject of another paper, to be laid before the Institution at a future meeting.

The Chairman said he believed the writer was quite within bounds, when he estimated the saving in fuel which might be effected in that district alone at 180,000*l*. per annum; nor was the subject of importance in that

light merely, because it was found to prevail as a general rule, that the amount of destruction in machinery and boilers was nearly in proportion to the quantity of fuel consumed. He had remarked at a former meeting on the practical importance of obtaining comparative accounts as complete as possible of the consumption of fuel, and economy of working of the steam engines in the different districts of the country, and he thought that all information of that kind was of great practical value.

Mr. Bowman inquired whether, in most of the engines mentioned, the proportions of Boulton and Watt were observed in the condenser?

Mr. W. Smith replied, that speaking generally, he believed that was the case, but the bad working of the engines was accounted for by the extraordinary pressure of the steam used. The error was, that engines intended and proportioned for 3 lbs. steam were worked up to 12 or 16 lbs. per inch throughout the stroke, and consequently, they were very imperfect in their condensing; as there was so much larger quantity of steam to be condensed at each stroke, when the cylinder full of high pressure steam expanded down to the same pressure as the low pressure steam.

Mr. Bowman observed, that this would seem to imply that the size of the condenser should be regulated by the pressure of the steam in the cylinder.

Mr. Cowper said, the pressure of the steam was certainly a necessary element to be taken into consideration, as well as the size of the cylinder, in determining the size of the condenser. There was not only a greater quantity of steam to condense when a higher pressure was employed, but also a greater quantity of air to pump out at each stroke of the air pump. He mentioned a case which came within his own observation in that district, where 18 lbs. steam was employed; there was no barometer gauge, but the parties were satisfied that they had a good vacuum; however, the fact was, that the injection water was forced into the condenser by means of a cistern at the top of the engine house, 22 feet in height.

Mr. Slate remarked, that he fully concurred in the results obtained by Mr. Smith, but feared they were so startling that there would be a disinclination to give them credence in the district. It was highly important then that the truth of the deductions should be practically admitted.

Mr. T. Thorneycroft, as an iron master of the district referred to, felt extremely obliged to the author of the paper for pointing out the means whereby any saving could be effected, more especially at a time when, owing to the state of the trade, economy in the manufacture was so essential.

Mr. W. Smith said, it had often occurred to him, that a steam engine was like no other machine. A time-piece, if out of order, was sent back to the maker to be repaired, and in the case of machines of other descriptions, if they did not do their work well they were immediately stopped, because they wasted and injured the material upon which they were employed. But when the old steam engine, after 20 or 30 years of hard labour, showed some symptoms of disorder, it could not be stopped; so with an extra application of the coal shovel, and some hammering at the cotters, &c., it was set to work again, and with its powerful steam arm it wound round

all the complicated machinery. This, however, was done at an enormous expense to the proprietor of the engine, and it would be much better if he were to renovate its constitution. He trusted that the exertions of the members of the Institution would have some influence in showing to persons of the description referred to, the necessity of carrying out these things on more efficient principles than they had hitherto been conducted.

Mr. Bowman thought it a matter of great importance that the injection water should spread itself out amongst the whole quantity of steam immediately on its passage into the condenser, and the alteration made by Mr. Smith in the mode of injection was very advantageous.

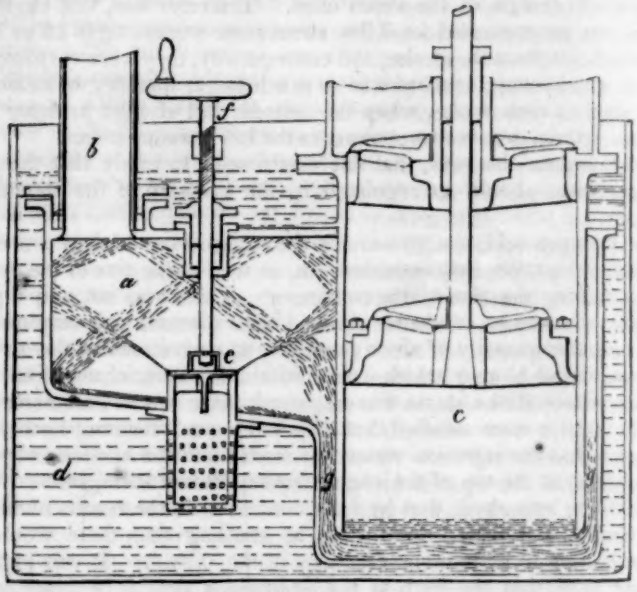


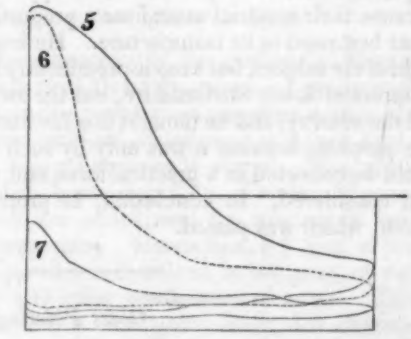
Fig. 4.

Mr. Cowper observed, that they ought all to add their testimony to the value of the indicator figures produced by Mr. Smith, because they showed the character of the engines much better than any judgment which could be formed with reference to them, inasmuch as it was the character of each engine written by itself, and could not be erroneous. He had not the slightest doubt, that a loss of 180,000*l.* at least, as stated by Mr. Smith, was sustained in that district, because the mode of condensing ordinarily adopted was exceedingly defective. It had occurred to him many years ago, that a valve might be put at the side of the condenser, and connected with an injection pump, so that a gush of cold water might be injected at every stroke, at the very moment of the entrance of the steam into the condenser, and shut off again immediately, by which means the greatest possible use might be made of the injection water, and the condensation of the steam effected with a smaller quantity of injection water.

He then explained the drawing of an improved injection valve which

he had constructed, and found to work very successfully: the object was to maintain the full pressure of the water at the point of entrance into the condenser, and to obtain a more efficient distribution of the jet of water without danger of its getting choked. In fig. 4, *a* is the condenser, *b* the eduction pipe, *c* the air pump, *d* the cold water cistern in which they are immersed; *e* is the injection valve, a conical valve rising a little above the bottom of the condenser, with a perforated cap below in the cold water cistern; this valve is lifted by the screwed rod *f*, and the admission of the injection water can be regulated with the greatest accuracy by the screw. The water enters the condenser in a fine sheet all round the valve, which strikes the sides of the condenser and fills the whole space with a fine spray; he had ascertained this by trying the valve in a box similar to the condenser, but partially open, with a column of water of the same pressure as the injection, and he found the distribution of the water was so perfect as to fill the box with a complete spray or fog. There was also a different construction in the air pump, which he considered advantageous; the bottom dropped into a well *g g*, in the bottom of the condenser, and the water rose up the space *g g*, when the air-pump bucket dipped into it, forming a water-valve instead of the ordinary foot-valve, and giving pressure enough to ensure the bucket-valve opening if there was any obstruction.

Fig. 5, shows the indicator figure, taken from the engine when in full work, at 24 revolutions per minute, driving shafting and two fans, and amounting to 72¼ indicated horse power. Fig. 6, is the indicator figure of the same engine when part of the work was thrown off, amounting to 38½ horse power; and fig. 7, is the indicator figure for the engine and four lines of shafting alone, without any work, amounting to 14 horse power, at the same speed of 24 revolutions per minute. The engine is high pressure, expansive and condensing, and is one of a pair working coupled together: there was originally in their place, a pair of high pressure engines, non-expansive and non-condensing, and the comparative economy of power effected by the present engines is so great, that although the same boilers only are used, there is 2¼ to 2½ times the power obtained.



The indicator figures exhibited by Mr. Cowper to the meeting, were drawn to the scale of 20 inches length of stroke, and one ½ inch for each lb. of pressure; and he begged to suggest that scale as a convenient one to be adhered to, for indicator figures intended to be exhibited to the Institution.

Mr. Slate thought the plan of injection proposed by Mr. Cowper was a very eligible one. With reference to the alternate injection of the water,

he had experienced the difficulty in marine engines, of too much water being admitted by the injection cock, whenever the engines were working slowly, causing the injection water to choke up the condenser and even get up into the cylinder, and he had adopted a slide valve in the injection pipe, admitting only water enough at each stroke of the engine for the condensation of the steam; the jet of water was thrown against a perforated distributing plate.

The Chairman remarked that there would be a tendency in the rose of the injection pipe, as adopted by Mr. Smith, to become choked up.

Mr. Cowper observed that, in the plan he had described, that difficulty was quite obviated, as in the case of the circular valve becoming choked, they had only to lift it up an inch or two by the screw handle, and then screw it down again, and the rush of water would effectually wash out any obstruction.

The Chairman considered that a great advantage, as it would prevent any stoppage of the engine. He thought the members of the Institution were much indebted to Mr. Smith for his researches, but their obligations were small compared with those of the iron manufacturers of the district, with whom he had been more immediately brought in contact, as the saving proved to have been effected by the improvement of the engines, formed so serious a proportion to the whole expense of working them. It was important that this subject should occupy the attention of the iron masters, because their material must bear a proportion in its price to the management bestowed in its manufacture. He hoped Mr. Smith would not lose sight of the subject, but keep it prominently before, not only the iron manufacturers of South Staffordshire, but the owners of steam engines throughout the country; and he thought this Institution was an excellent vehicle for the purpose, because it was only by such an Institution that information could be collected in a practical form, and the results be duly investigated and considered. In conclusion, he proposed a vote of thanks to Mr. Smith, which was passed.

---

*Glass Painting.**

From an able article in the *Journal of Design* on painting upon glass, we extract the following:—

We have fortunately some directions given us in a manuscript of the end of the 14th century, which in part bears traces of Byzantine science; it gives the process of the manufacture of various colored silicates and fluxes for the purpose of ornamenting glass. This MS. was copied in the 16th century at Bristol, and is now in the British Museum. (Sloane MSS. in British Museum, No. 3661.)

Colors for Tinting Glass.

Blue or blavus color—cobalt, or ultamarine, with purified crystal glass.

Emerald color—from oxide of copper and yellow oxide of iron.

Ruby color—from tartar, copper, and iron, or carbonate of potash and yellow oxide of iron.

* From the London Architect, for November, 1850.

Carbuncle—gold calcined, 1; carb. of potash, 2.

Sapphire—blue bi-carbonate of copper, or ultamarine, 1; potash, 2.

Jacinth—protoxide of gold, ½ part; ground iron, ½ part; potash, 1.

Emerald—red oxide of copper, a little; potash, 2.

Topaz—protoxide of lead; protoxide of gold, a little; potash, 2.

Garnet—protoxide of gold; hæmatite, a little; potash, 2.

Chrysolite—oxide of zinc, 1; potash, 2.

Turquoise—protoxide of gold, ½; blue bi-carb. of copper (*lapis armenus*); potash, 2.

Cornelian—oxide of tin, ½; potash, 2; golden marcasite, ½; oak ashes, ½ part.

Sapphire—1 lb. finely ground crystal; ½ lb. calcined stag bones; ½ lb. carb. of potash; melt it, and afterwards place ultamarine blue. (This glass would be opaque.)

Flux—nitrate or bi-tartrate of potash and borax, equal quantities, with ceruse; mix with oil of eggs into a paste.

Or crystal calcined, 1; carb. of potash, 2.

Or crystal and oil of tartar fused together, and add nitre.

Or glass well burnt, powdered, and washed, and melted with an equal quantity of borax.

---

*Method of Ascertaining the Value of Indigo.**

Dr. Bolley, after showing the inaccuracy of the methods of Chevreul, Schlumberger, &c., recommends the following process:—1 gramme of indigo, (15·4 grains) is rubbed to a fine powder in a porcelain mortar; about 10 grammes of fuming sulphuric acid are added, and it is then kept covered for six or eight hours, being occasionally stirred. The whole is then put into an evaporating dish, containing 2 lbs. of water; 50 grms. of concentrated hydrochloric acid are added, and the mixture is boiled. The water is replaced as it evaporates. Meanwhile, a ¼ grm. of warm dry chlorate of potassa in fine powder is dissolved in 100 grms. of water, in a graduated tube, holding 100 cubic centimetres of water. This is then added to the indigo solution, at first pretty freely, but afterwards more gradually, allowing the mixture to boil after each addition. The liquid changes from blue to green, greenish-brown, and at last into a red-brown. These changes may be observed by marking a piece of white filter from time to time with a rod dipped in the solution.

On Detonating Sugar.†

In a meeting of the Royal Academy of Turin, for 31st January, 1849, Professor Ascanio Sobrero announced his discovery of a detonating sugar, obtained from that material, by means similar to the mode of preparing gun cotton.

Take pounded loaf sugar and pour on it a mixture of two volumes of

* From the London Artizan, for January, 1851.

† From the Edinburgh New Philosophical Journal, for January, 1851.

sulphuric acid, (at Baruné 66,) and one volume of nitric acid (at 43). Immediately the sugar is converted into a tenacious viscid substance, which is only partially dissoluble in the acids employed. On adding a large quantity of water, (about twenty times that of the acids employed,) the sugar is converted into a material with the following properties. It is very white, diffusible in the acid mixture, and absolutely insoluble in water, but very soluble in alcohol and sulphuric ether. When subject to a moderate heat, it melts, and is decomposed without detonation: but if suddenly heated to redness, it explodes like gunpowder, producing gaseous emanations, in which it is not difficult to recognize the nitrous vapor and that of cyanogen. By the blow of a hammer it also explodes, but feebly.

The composition of this fulminating sugar it will not be difficult to determine—more easily than that of gun cotton—from its more slow decomposition under a graduated heat, when it may be exposed to the action of oxide of copper. Professor Sobrero, however, had not completed his analysis when his paper was read. Its composition may lead to the better understanding of other fulminating compounds, and we may be able to obtain fulminating substances by similar means from starch, flour, &c.

For the Journal of the Franklin Institute.

Fresh Water Condensers for Marine Steamers.

The condenser of Mr. J. P. Pirsson, which was noticed in the Journal some time since as being in use on board the steamer "Osprey," running between this port and Charleston, has been examined within the last few days, (while the ship was being refitted for the coming season,) and found to be as perfect as when first put in use—the tubes, both internally and externally, were found to be perfectly clean, and the boilers free from scale. B.

---

*English Patent Law.**

The following order relating to patents has been made by the Attorney General:—"The Attorney General, with the assent and concurrence of the Solicitor General, hereby gives notice, that every person applying for a patent after the 2d day of November inst., will be required to deposit in the office of the Attorney or Solicitor General an outline description in writing or drawing, to be approved by the Attorney General or the Solicitor General, before any report will be made on such patent. (Signed) John Romilly, Lincoln's Inn, Nov. 2, 1850.

Influence of Light on the Chemical Action of Oxygen.†

At the recent meeting of the Swiss Association for the Advancement of Science, Professor Schönbein read a paper on the Influence of Light upon the Affinities of Oxygen. He finds that oxygen, either pure or as

* From the London Architect, for November, 1850.

† From the London Artizan, for December, 1850.

found in the air, combines with sulphuret of lead under the influence of the solar rays, converting it into the white sulphate. In the dark, all other circumstances remaining the same, there was no perceptible action. In a strong summer sunshine the change took place in 15 minutes. Hence paper coated with the sulphuret of lead may be used for photographic purposes. It is not, however, sensitive enough for the camera. The sulphurets of arsenic and antimony are less easily affected. He shows likewise that the affinity of oxygen for some other substances is much increased by solar action, independent of heat. Thus he has, by the same means, transformed common oxide of lead into a compound of the protoxide and peroxide. To this existing power he refers various instances of slow oxidation in the open air, especially common bleaching. He further supposes that the electricity of the clouds has a voltaic origin, arising from the electromotive action of oxygen, under the influence of light, upon the water contained in the atmosphere.

---

*Albuminizing of Photogenic Glasses.**

We have received from Dr. Maunoir a translation, made at the request of M. Scarpellini—the President of a Society having its meetings on the Capitol, called *Romana Corrispondenza Scientifica*,—of a paper published in the Society's Journal, by M. Luigi Ceselli, on a new process for "albuminizing photogenic glasses." It appears to point out a method by which extreme uniformity in the thickness of the film may be obtained:—and we print it from Dr. Maunoir's manuscript, with a few verbal alterations, where there appears to be a want of clearness, arising from the difficulty which a foreigner writing in English must necessarily experience when not thoroughly familiarized with the idiom of the language.

It cannot be denied that photography has gained much by the substitution of glass for photogenic paper; as thus has been obtained a high degree of transparency of the plates for the process, a modification of that applied by Daguerre to the grand discovery of the celebrated Neapolitan, Gio. Batt. Porta, which discovery remained forgotten for nearly two centuries. Many difficulties, however, still existed; for, with the use of glass, a layer of albumen was necessary to the production of those wonderful results obtained by the rays of light. Again, to cover the glass with a layer of albumen of equal thickness, so that the light may produce everywhere the same effect, to prevent any inequalities forming on the surface during the drying process, to produce the layer at one stroke,—such were the difficulties which, notwithstanding repeated experiments, yet remained to be overcome, and had retarded the progress of this wonderful new method,—but which, it seemed to M. L. Ceselli, did not deserve to be abandoned, as it had, to be replaced by the improvements obtained with photogenic paper.

* From the London Athenæum, November, 1850.

After having studied the various processes in use, M. L. Ceselli invented a small simple machine, which he has found to obviate every difficulty.

It consists of a small rectangular box, supported by three regulating screws. To its base is joined a movable plate of metal, which, being heated by means of a lamp of alcohol, communicates to all the parts of the box an equal degree of heat. The plate is removed when the water bath is to be used instead of the lamp. The apparatus is protected by a glass covering, to guard against heterogeneous bodies falling on the albumen. This cover is also movable; and the box being traversed by an internal channel, in this, when convenient, a thermometer may be introduced. A sliding frame receives the glass which is to receive the preparation; this, again, being placed between two other plates of glass. The glasses are secured and their edges brought to correspond by means of a tightening screw,—so that the albumen, when either spreading or shrinking, may always cover the whole surface of the intermedial plate of glass. The frame is furnished on two parallel sides with a small groove to receive the albumen,—which a small round edged knife, elevated to the proper point by means of two spiral pivots cased in the sides of the box, and kept down in a parallel direction to the glass by means of a screw, serves to remove, producing by this means the exact thickness of layer which is required. The frame is furnished along one of its sides with an indented ridge, to which a wheel provided with an external handle corresponds, so that the frame can be made to move with such velocity as the operation may require.

---

*Common Meridian for all Nations.**

We find it stated in the French journals, that in consequence of the confusion existing between the maritime calculations of different powers, and the unfortunate occurrences to which it sometimes leads, the naval powers of the north—Russia, Sweden, Denmark, and Holland—have entered into an agreement to open conferences on the old question of a common meridian for all nations. France, Spain, and Portugal, it is said, have given in their adhesion to the scheme; and a hope is held out that England will come into the arrangement. There never has been, and there never can be, a doubt as to the utility to science of common points of reference and uniformity of regulation; and no local jealousy should be allowed to stand in the way of them. The most advanced opinion on the Continent seems to be in favor of the selection of an entirely neutral point of intersection,—say Cape Horn,—which would have the immense advantage of being agreeable to the Americans. If the Admiralty are disposed to go with this movement, there seems a probability of establishing once and for ever this great maritime desideratum.

We are glad to see the English journals advocating this change, which, unless we are mistaken, our own government endeavored some years ago

* From the London Athenæum, November, 1850.

to effect, but unsuccessfully. We think, however, that the editor of the *Athenæum* is supposing that Americans will be in favor of Cape Horn. We do not believe that we have sufficient vanity of *hemisphere* to lead to that result, especially as it would be a very awkward meridian for our trade. We think, in all respects, the best meridian would be that of the Cape of Good Hope, which has, among its other recommendations, that of being the locality of a renowned observatory, established by England. Could not longitude be also hereafter reckoned to 360°? F.

---

*The Boiler Explosion at Halifax.**

The coroner's inquest upon the bodies of the ten persons killed by the boiler explosion at Messrs. Firth's woollen manufactory, Lilly-lane Mill, Halifax, which was recorded in *The Times* at the period of the calamity, was brought to a close on Friday evening last. A great mass of evidence was adduced, the general tenor of which was, that Mr. Samuel Firth, if not other of the partners, was aware that the exploded boiler was unsafe for use, and yet that it was kept working at intervals up to the time of the explosion. Once or twice previous to the explosion the steam was turned off, and the machinery stopped, while Firth and the engine-tenter tinkered at the boiler, which was constantly leaking; and on the day before the boiler burst, Firth ordered the young people out of the engine house, (where they had been accustomed to warm themselves,) telling them that "they were to get away as fast as they could, lest the boiler should burst." The young people naturally became alarmed, and one of them, Lavinia Carter, attempted to leave the mill, but was ordered back by Samuel Firth, and shortly after her resuming work the explosion took place. This, however, was not the most serious part of the evidence against Samuel Firth. Mr. Thomas Wood, cotton spinner, of Sowerby-bridge, stated, that two days before the explosion, he met Samuel Firth in Bradford Cloth-hall, when Samuel said, referring to the explosion at Messrs. Waud's Bradford mill, "We have had a good deal of bother about engineering this week. Our old engine is poorly, and I have had to look after the man a good deal, lest he should get his pressure too strong on the boiler. I am afraid there will be a blow up at our place, but we must run on till Christmas." The most important evidence given during the inquiry, was that of Mr. William Fairbairn, the eminent civil engineer and machinist, of Manchester, who had been sent for by the mayor and magistrates of Halifax to view Messrs. Firth's boilers, and report thereon. His evidence is important, not only as showing how the accident occurred, but as suggesting a precaution against these dreadful catastrophes in future. Mr. Fairbairn put in a written report of considerable length, of which the following are the chief points:

"The comparative saving which is effected by the judicious application of high pressure steam in its expansive action upon steam engines, and when due care is taken that the vessels within which it is confined are calculated to resist with perfect security the forces by which they may

* From the London Artizan, for January, 1851.

be assailed, does not admit of doubt. I think it is equally for the general benefit of the country and the extension of our manufactures, that every facility should be given for its introduction, and I take this opportunity publicly to state, that, in my opinion, it may be accomplished with perfect safety, and with greatly increased economy in the consumption and employment of the most valuable mineral production this country possesses. The danger does not consist in the intensity of pressure to which the steam may be raised, but entirely upon the character and construction of the vessel which contains the dangerous element. When contained within the narrow limits of a well constructed locomotive boiler, it is perfectly harmless; but if it be attempted to enclose a volume of similar density in an ordinary boiler of extended capacity, you incur the almost certain result of a catastrophe, such as we have so recently been called upon to deplore. Such, it appears to me, was the position in which the public were placed with respect to the boilers of the Lilly-lane Mill. They were worked (especially two of them) in a very unsafe condition; and I have no hesitation in stating, that they were unequal to the pressure to which they were exposed. Insecure to begin with, they were rendered immeasurably more so from the absence of proper safety valves —an outlet of only three inches diameter, which was common to all the three, being scarcely worthy of the name. From every inquiry, there is no evidence to show at what pressure the valve was weighed, or whether or not it was ever in a working condition. I am not aware what may be the practice in this or other parts of Yorkshire; but I cannot sufficiently condemn a system of construction which limits the means of escape, and exposes both life and property to the most eminent peril. The boilers at Lilly-lane Mill were of such magnitude, and the plates of which they were composed so extremely thin, that I should have considered them at any time very precarious. Assuming all the parts to be perfect, which is, however, doubtful, we shall find that 12 lb. on the square inch was; although sufficient to distort the form, totally inadequate to effect the rupture of the boiler. Taking the tensile strength of the material, and the joints of which the boiler was composed, it was equal, under a more judicious distribution, to ten times that pressure; but, unfortunately, the extreme thinness of the plates, and the want of sufficient stays, caused the flat ends to bulge outwards, which, under the influence of a variable force, created a slow but certain strain upon the angle iron, which ultimately destroyed its texture, and rupture ensued. The boilers were originally supplied with water by self-acting jackheads or columns of water, at the usual height of 12 or 14 feet. These, it appears, were taken down some years since, when the new end of the mill was built over the boilers, and valves or cocks worked by hand substituted for them. Now, the hand-feed, direct from the pump, in well constructed cylindrical boilers, with double safety valves, may be perfectly safe; but in this case, when the steam escape was so insufficient, they were very injudicious, and in fact, the removal of the jackheads did away with almost the only security that the boilers originally possessed. Before the engine is again started, I would earnestly recommend that the boiler next the engine-house be discontinued and destroyed, and that the other boiler with hemispherical ends be removed from under the mill, if it is possible to do

so. Having made these statements, it now becomes my duty to state, for the information of the authorities of Halifax and the public generally, what I consider the most feasible means for averting, or at least diminishing, the number of these frigh ful accidents arising from boiler explosions. It appears to me, that a legislative interference in the construction of boilers, or machinery of any kind, is exceedingly objectionable, and should not be resorted to but in cases of urgent necessity; yet I do not clearly perceive how local regulations, however good and judicious in themselves, would answer the purpose, unless under the control and sanction of the law. I apprehend the assistance of Parliament would be required to carry out the principles I would suggest, as follows:—1st. That after a certain date boilers should not be allowed to be placed under buildings where people are employed, and that those now in that position be as speedily removed as possible. 2d. That boilers of a wagon shape should not be worked at a pressure exceeding 10 lb. on the square inch. 3d. That after a certain date every new boiler should be proved up to not more than one-third its bursting pressure, and to three times its intended working pressure. Lastly, That every boiler should be fitted with two safety valves, one to be self-acting, and beyond the reach of the engine tenter, or any other person but one to whom the duty of examination should be expressly intructed."

After the evidence had been closed, the coroner, Mr. G. Dyson, having summed up, the jury retired, and after being in consultation for upwards of three hours, returned with a verdict of "Manslaughter against Samuel Firth, one of the proprietors of the mill, and Joseph Helliwell, the engine-tenter," and the coroner proceeded to make out their commital to York Castle for trial at the assizes.

---

*Steel Pens.**

The following interesting particulars are condensed from the *Morning Chronicle:*—Steel pens are almost entirely manufactured by women and young girls; and it is probable that out of the 2000 persons or upwards now engaged in the business, not above 100 or 150 are of the male sex. The manufacture of pen-holders, and that of pen-boxes, give employment to an additional number of women and children, variously estimated at from 200 to 400 persons. About the year 1820 or 1821 the first gross of "three-slit" steel pens was sold, wholesale, at the rate of 7*l.* 4*s.* the gross. In 1830 they had fallen to 8*s.*, and in 1832 to 6*s.* the gross. A better article is now sold at 6*d.* per gross. One factory alone, in Birmingham, produces them at the rate of no less than 40,000 gross, or 6,760,000 in a week—very nearly a million, or 960,000 per working day, or 289,528,000 per annum. At the very lowest calculation, Birmingham produces 1000 millions per annum. The cheapest pens are sold as low as 2*d.* per gross, wholesale; and the price rises, with the elasticity and finish of the pen, up to 3*s.* 6*d.* and 5*s.* per gross. Birmingham produces them all, and one establishment has the distinctive marks of 500 different dealers in all parts of the country, as well as on the continents of Europe and America, for whom he manufactures according to order.

* From the London Builder, January, 1851.

The sheets of steel, received from Sheffield, are reduced to the requisite tenuity by successive transits through the rolling-mill operations, tended by men and boys. When reduced to the thinness of a steel pen, length about 2 feet, breadth 2½ to 3 inches, the sheets are ready for punching out the blanks. This process is performed with great rapidity—one girl, of average industry and dexterity, being able to punch out about 100 gross a day. The next operation is to place the blank in a concave die, on which a slight touch from a convex punch produces the requisite shape: that of the semi-tube. The slits and apertures to increase the elasticity, and the maker's or vendor's name or mark, are produced by a similar tool. Previously, however, the pen undergoes a variety of other processes. When complete all but the slit, it is soft and pliable, and may be bent or twisted in the hand like a piece of thin lead. Being collected in "grosses" or "great grosses," the pens are thrown into little iron square boxes by men, and placed in a furnace, where they remain till box and pens are of a white heat. They are then taken out, and thrown hissing hot into pails or tanks of oil, when they may be broken like so many wafers: after draining, they are made to revolve rapidly in a perforated cylinder.

Hydraulic Mortar, as made and used at the Docks, Liverpool, 1850.*

Few engineers or architects who have visited Liverpool will have neglected to examine the docks, constructed under the direction of Mr. Hartley, and if they have noticed the character of the recent work, they will have observed that the river walls, entrances, and dock walls are principally of rubble masonry. The strength of this work in a great measure depends upon the good quality of the mortar used. From inquiries, we obtained the following particulars as to the mortar, which may be useful to some of our readers. The dock works at Birkenhead are constructed with similar mortar. In fact, it has been made principally by men from the Liverpool works. The stone is obtained from Halkin mountain, near to Holywell, Flintshire, North Wales; it is shipped in the river Dee. Price of stone delivered upon the quay at Liverpool, per ton, 7*s*. 3*d*. When it is requisite to burn the stone quickly, coke is used, at per ton 16*s*. When not required quickly, coal is used, at per ton 8*s*. 6*d*. The stone can be burned quickly for as little money with coke as it can be burned slowly with coals. But it is very expensive to burn quickly with coals or slowly with coke. The proportion of coke is generally one bushel to six bushels of stone.

Cost of Burning the Limestone.

Tons.	Cwt.		Per Ton.	£	s.	d.
4	10	of limestone,	7*s*. 3*d*.	£ 1	12	7½
—		labor on do.,	1*s*. 6*d*.	0	6	9
1	10	of coke,	11*s*. 0*d*.	0	16	6
				£ 2	15	10½
Produce: Lime, 3 tons, at 18*s*. 7½*d*. per ton,				£ 2	15	10½

* From the London Builder, January, 1851.

Mortar from the mill costs, per cubic yard, from 9*s.* 6*d.* to 10*s.* 6*d.*

N. B. Various quantities of sand are used, from two to five, to one of lime by measure. Smith's ashes, or furnace ashes, are used to mix with the lime, and with much advantage.

The sand is obtained out of the river Mersey, generally from the great banks above the town.

The lime-kilns stand close to the mortar shed; the lime is drawn fresh from the kiln mouth, is slaked, and thrown at once into the mortar pans, which are driven by steam power. The mortar is used fresh, generally on the day it is made. It sets rapidly, and in a few months the rubble becomes one solid mass. Grout is used plentifully, made from the same mortar.

---

*The Voltaic Light.**

There was a private exhibition of this light at the Polytechnic Institution on Saturday, which, we believe, was the first of a series of experiments, to precede its permanent application in the chemical lecture room of that establishment, instead of the gas, which has hitherto been used. The effect of the light was brilliant in the extreme, and the simplicity of the apparatus is favorably contrasted with other machines of this kind which we have examined.

It appears from the statement which was handed round that, under all other patents in this country, machinery in the nature of clock-work, or acting by some motive power, foreign to the voltaic current, has been employed to regulate the proximity of the *electrodes*—the term by which the carbon points are ordinarily designated. We assume that every one who will take an interest in this topic understands that the electric, or, more properly speaking, the *voltaic light*, is produced by the process of bringing two pieces of carbon, in the shape of pencils, forming part of the galvanic circuit, into contact, and separating them, so as to cause the manifestation of the electric incandescence, or light; and that it is necessary to maintain a regular proximity of the points, for if again brought into contact, or separated too far, the light will cease.

The impurities of the carbon, the impossibility of making two of the carbon pencil points, or electrodes, of the same size, or of the same density, the variation in the supply of the voltaic current, and other causes, must render the arrangement of the distance of the points a matter of uncertain and fluctuating regulation; for which reason, it is evident that machinery cannot of itself prevail for the required purpose. Mr. Stait has endeavored to supply the necessary means of regulating the distance by a kind of electric governor, with a reciprocating motion of an induced magnet in an electric coil within the circuit, which communicates with the motive power, or clock-work, and effects to control it.

Mr. Allman goes a step further, and makes the voltaic current itself the regulator by a direct action upon magnets in contact with the carbon electrodes. The merest tyro in physical science must be acquainted with

* From the London Mining Journal, No. 794.

the action of the ordinary electrometer, which consists of a magnetic needle, moving on an axis, in a flattened *helix*. Let us suppose this electrometer turned, so that its magnet may move vertically instead of horizontally; that to one end of this magnet is attached a rod, in which the pencil-shaped carbon electrode is secured; that the pointed end of another carbon electrode is placed in contact with the one joined to the magnet. This is the principle of the present simple invention. The voltaic current passing through the electrodes, when contact is broken, becomes incandescent; and the action of it in passing through the coil affords the means of maintaining the carbon points at their appropriate measure of approximation. Thus, exclusive of the stand, conductors, and battery, the lamp consists of no more than three parts—the coil, the magnet, and the carbon holder; and the inventor informed us that, ornament apart, it might be made for 1*s*. 6*d*.

There were three lamps exhibited—one suspended from the ceiling; one upon a fixed pedestal; and the third a table lamp. The light was shown from each of them by turns; and, although a trifling *contretemps* occurred when the first one was alight, on the whole, there was sufficient to justify us in saying that, as an experiment, the exhibition was successful. The statement circulated on the occasion, in discussing the introduction of the voltaic light as a competitor of gas, compares the details of the two systems. It alleges that the voltaic lamps may be sold at prices equal to gas lamps, and to last 20 years for the three years which gas burners will endure; and that the mains and source of production of the two systems will give results much in favour of the electric light.

As to the comparative cheapness of coal gas and electricity, it proceeds as follows:—

Coal gas, as a manufacture, has now arrived at its mature state. Millions have been expended to perfect it. Talent, labour, money, and competition have done all that could be done to render it useful, cheap, and elegant in use. Now, assuming the price to be (say) 4*s*. per 1000 feet, we will examine what chance voltaic electricity has of competing with it, on the score of economy. The present state of the manufacture of electricity may be compared to the time when coal gas was made for the lecture table, before a pound was expended in its manufacture, and before it was even determined or thought possible to apply it to useful or commercial purposes; in fine, before the want created the manufacture, and brought it to maturity by the expenditure of money, science, labor, and experience, employed during a series of years. Electricity is at present produced from lecture table apparatus, and without the benefit or the advantages which have brought gas to its present state of perfection; yet electricity, under all these disadvantages, if produced from one of the present lecture table apparatus, and one of the dearest in use, will produce a more light-giving agent for 8*s*. than 8*s*. worth of coal gas at 4*s*. per 1000 feet.

If Mr. Allman's present experiments make out this fact, it will be sufficient to justify every effort to procure the adoption of this extremely beautiful agent of artificial illumination.

*On a Method of Fixing Colors upon Tissues.**

When an egg is boiled in a color bath, the color immediately fixes itself to the shell. Egg-shells contain, like bones, an organic tissue and mineral salts. If it is attempted to dye these mineral salts, the phosphate or carbonate of lime, separately, it falls, and therefore neither of these salts can be the mordant. If, on the other hand, we attempt to color the organic tissue of egg-shells, or of bones, this immediately becomes dyed; hence it follows that the organic matter of the bones and egg-shells is the mordant. Now in the same manner as mineral mordants have hitherto been employed to fix coloring matters upon cotton, organic mordants may be used, and Broquette has already employed caseine for this purpose. The coating of vegetable fibres with animal matter was first carried out by Hausmann, as observed by Barreswil, but is said never to have reached any importance. The caseine must of course be first dissolved, in order that the tissues may be penetrated by the solution, but it must then be rendered insoluble in the tissues. Now it has been shown by Braconnet, that caseine forms a soluble compound with ammonia, which is again decomposed by boiling. Broquette therefore impregnates the goods with a solution of caseine in ammonia, then heats them to expel the ammonia, upon which the caseine remains in an insoluble state in the tissues. Cotton goods thus treated are saturated with animal matter, and may be now dyed in the same color baths as those used for woollen tissues. Frequently the dyes are alkaline; they then dissolve the caseine instead of being fixed by it. But since Bachelier used a mixture of lime and caseine as a cement, it has been known that such a mixture hardens and becomes fixed. Broquette therefore employs the caseine sometimes with lime alone, sometimes with ammonia and lime together, and saturates the goods with this caseate of lime, which, in a warm atmosphere, soon sets, and then resists the alkalies and rinsing with alkaline liquids. By this treatment the cotton acquires a peculiar stiffness; so that, although its capacity for dyes has become nearly equal to that of wool, it is far behind the latter in lustre. But this evil also can be remedied by mixing the mordant with oil. Oil, caseine, and lime, form a mordant which fixes the colors with remarkable lustre. When the goods to be dyed consist of wool and cotton, a different plan has to be followed; the mordant, in this case, is not adapted for the two materials; the wool is deprived of its natural lustre, and the cotton is not sufficiently penetrated. For such goods Broquette employs the mordant before the weaving; it is applied to cotton in the spinning, when it can afterwards be woven and bleached like wool, without the mordant receiving any injury. When threads thus prepared are woven, the tissues can be dyed just like woollen stuffs without further treatment. By means of the solution of caseate of lime, mineral colors which are insoluble in water can he adapted to the dying of stuffs; they are mixed with the solution in the state of very fine powder. These liquid colors, which can be prepared with ultramarine, ochre, etc., can again be removed with water, unless they have been dried; but as soon as they coagulate, they adhere firmly to the tissues inclosing the coloring

* From the London Artizan, for December, 1850.

principle. A farther application of this mordant of caseine, oil, and lime is in the printing of stuffs; in this case we are not limited merely to mineral colors, which, by its aid, may be fixed upon the goods, but the numerous vegetable colors may likewise be very well applied, by first converting them into lakes by means of alumina or protoxide of tin, and then using these lakes in the same manner as the powdered mineral colors. After being printed, the goods are wrapped in moist linen, and left for about half an hour in the moist vapor in a warm atmosphere. During this time the impressed color does not dry superficially, but is absorbed into the interior of the fibres, and is then completely fixed in a subsequent drying.

This new method of mordanting has already had considerable influence upon several pigments, such as archil, which has only been used for dying exceptionally. By Broquette's process some very beautiful colors are obtained from it, modifications of the peculiar color of the archil by lime. It will be evident that in this process of dying it is requisite to pass the goods through a lime bath, which will not do for many dyes, as the colors have their tints altered by such treatment. In such cases magnesia is to be substituted for lime. When goods are printed with the mineral colors or lakes according to the above process, very full colors are obtained, which, in the case of many patterns, is not desirable. To bring out the shades and half colors in the full colored impressions, the printed goods are placed with the colored surface upon an absorbing ground, and the forms pressed on the back. The printed portion pressed upon the absorbing surface is deprived of some of its color, and numerous patterns can be produced in this manner.

Translated for the Journal of the Franklin Institute.

New Process for Photography on Paper, by which Positive Pictures may by obtained directly. *By* M. F. Bousigues. (*Extracted by the Author.*)

Any very even, slightly sized paper, free from stains and metallic spots, may be perfectly well applied to this new process. The papers of Canson & Lacroix, of Angoulême, have given me the best results.

Three sheets are to be taken and dipped successively in distilled water, and stretched upon the glass of the frame, taking care to make them adhere at every point by means of a very fine linen. The one which appears best fitted to receive the impression from the light is to be placed upon the others; the latter serving only to maintain the adherence and moisture.

When this moisture has disappeared, three or four drops of neutral nitrate of silver must be let fall on the surface of the paper, and rapidly spread by means of a brush. The traces of this solution disappear in a few minutes, leaving nothing on the paper but the appearance of a light vapor. In this state the paper is to be treated in the same way as a metallic plate. The vapors of iodine, and of the bromide of lime, will give it great sensitiveness, but it will be necessary to expose it for a longer time to the vapors of this latter substance.

Here are such figures as I can give:—First iodizing 15 seconds; bromine 35 seconds; second iodizing 10 seconds.

The glass is then placed in the frame and exposed to light, which operates on the paper almost with the same rapidity as on the plate of silver. Mercury makes the image visible.

If the operation is well done, the exposure to light properly regulated, we obtain a positive image of a beauty comparable to that which the plate gives, and at least very superior in the softness of its tints to those by the ordinary process with gallic acid.—*Proc. Acad. Sci., Paris, 28th Oct.*, 1850.

For the Journal of the Franklin Institute.

Description of the Naval Dry Dock at Brooklyn.

The stone dock at the Brooklyn Navy Yard being so far completed as to be used for the purposes intended, I send you the following description of it:

Length of dock from caisson to head	348	feet.
Width of chamber at coping	98	"
Depth of water at high tide	27	"

Gross amount of stone used, 30,000 cubic yards.
Cost, up to January 1st, 1851, $1,933,640.

For pumping out the water they have a vertical beam engine, having a cylinder of 50 inches diameter, and 12 feet stroke; the beam is of cast iron, 32 feet long, and at the opposite end from the cylinder there is a connecting rod attached to the crank shaft, on which is a fly-wheel of 24 feet diameter. There are two single acting lifting pumps, (one being worked from each side of the beam,) lined with composition, 63 inches diameter and 8 feet stroke. The quantity of water to be removed is about 600,000 cubic feet, and the time occupied 3 hours; the smallest lift being 2½ feet, and the greatest 26 feet. Connected to the engine are three drop flue boilers, so arranged as to be used singly or together, at pleasure. The cut-off valve used on the engine is separate from the steam valves of the engine, and is so arranged that it may be adjusted at pleasure while the engine is in motion. The engine and pumps are a fine specimen of work, and were constructed by Mr. Kemble, at the West Point Foundry. B.

On the Economic Values of Coals used in the Collins' Tubular Boiler.

To E. K. Collins, Esq.,
Agent for the New York and Liverpool Steamship Co.,

New York, Dec. 24, 1849.

Dear Sir,—Having received orders from you to test, by experiment, the evaporative values of several kinds of Coal upon your "Vertical Tubular Boiler," and having discharged such duties, we hereby enclose you a copy of the report of said experiments with our views annexed.

Our first experiment was with the Dauphin Rattling Run. It possesses high evaporative power, with considerable cohesion of its particles, so that it may not be broken into too small fragments by the constant attrition which it may experience in the vessel. It ignites very quick with natural draft, burns with a clear bright flame, leaving but a slight soot deposit upon the tubes, owing to the free circulation of the air through the grate bars, rendering the combustion more perfect. In short, it requires little if any attention from the fireman until it is necessary to charge the furnaces with a fresh supply of coal.

Our second experiment was with the Baltimore Cumberland. It ignites rapidly, producing a strong heat; shortly after which time, it runs together, often adhering to the grate bars, requiring much time and labor to separate it. Without the strictest attention, in a short time, it would entirely exclude the air from penetrating through the interstices of the coal, thereby producing a great loss of steam. It has very small cohesion of its particles, requiring very careful handling to prevent it from crumbling into very small pieces.

Our third and fourth experiments were with "Young's Mining Company" and "Maryland Mining Company." They produce the same effect as the second experiment, the results being all forced.

Our fifth experiment was with the Erie—possessing rapidity of ignition, makes an intense fire, throwing off an immense volume of carbonaceous matter, causing the tubes to fur up in a very short time, also having an undue quantity of sulphur in it.

Our sixth experiment was with the Dauphin Rattling Run; varies nothing from the first experiment.

Our seventh experiment was with the "Maryland Mining Company;" results as before.

Eighth experiment was with the Dauphin Backbone, slightly differing from the Rattling Run in evaporation and rapidity of ignition.

Ninth experiment was with the Dauphin Rattling Run; still retaining the pre-eminence for marine purposes over any of the coals submitted for trial, requiring less labor by 75 per cent.—producing more steam in less time than any of the coals experimented with.

Our tenth experiment was with the "Maryland Mining Company." Experienced the same difficulty as before, viz.:—running together, forming a heavy compact crust over the whole area of the grate, requiring frequent raking that the air might circulate through and ignite the surface or top of the coals, thereby occasioning the furnace doors to remain open much longer than the circumstances of the case ought to justify.

Having given a brief review of the coals submitted to us for trial, it may be well to add, that the Dauphin Rattling Run (for marine purposes) meets our decided approval, from the experiments we have had of it.

We remain, dear sir,

Yours very respectfully,

(Signed) NATHAN THOMPSON, JR.
JAMES THOMPSON.

TABLE SHOWING THE ECONOMIC VALUES OF THE COALS CONSUMED IN A "COLLINS' VERTICAL TUBULAR BOILER,"

TABLE SHOWING THE ECONOMIC VALUES OF THE COALS CONSUMED IN A "COLLINS' VERTICAL TUBULAR BOILER," AT THE NOVELTY WORKS, NEW YORK, DECEMBER, 1849.

Names of Coals employed in the experiments.	Evaporating power or No. of pounds of water evaporated from 40° by 1 pound of coal.	Evaporating power, or No. of pounds of water evaporated from 212° (latent heat 1000°).	Rate of evaporation, or No. of pounds of water evaporated per hour.	Quantity of water evaporated in all, pounds of.	Number of pounds of coal consumed per hour.	Number of pounds of coal consumed per square foot of grate surface per hour.	Total pounds of coal consumed in all.	Number of sq. feet of grate surface.	Number of square feet of fire surface.	Ashes, per cent. of	Mean pressure of steam in pounds.	Temp. of feed water.	Temp. of Air.	Temp. of Chimney.
Dec. 5. Dauphin, Rattling Run,	7·510	8·082	523·875	2095·50	69·750	16·41	279	4·25	126	12·37	24·00	40°	39·0	290
" 6. Baltimore, Cumberland,	7·202	8·452	468·187	1872·75	65·000	12·70	260	"	"	11·74	22·00	40	37·0	297
" 7. Young's Mining Co., do.,	6·618	7·762	443·437	1773·75	67·000	13·41	268	"	"	12·97	22·00	40	36·0	295
" 8. Maryland Mining Co., do.,	6·788	7·962	459·937	1839·75	67·750	15·94	271	"	"	12·00	22·25	40	39·0	294
" 9. Erie, New York,	5·871	6·880	402·187	1608·75	68·500	16·11	274	"	"	6·42	19·75	40	36·0	330
" 10. Dauphin, Rattling Run,	7·425	8·702	495·000	2970·00	66·660	15·68	400	"	"	12·54	24·00	40	34·0	297
" 11. Maryland Mining Co.,	7·520	8·814	425·428	2978·25	56·570	13·31	396	"	"	11·62	22·61	40	39·0	294
" 12. Dauphin, Backbone,	7·389	8·652	519·750	3118·50	70·330	16·43	422	"	"	12·77	23·50	40	40·0	294
" 16. Do. Rattling Run,	7·858	9·209	552·708	3316·25	70·330	16·43	422	"	"	12·51	24·00	40	37·0	297
" 17. Maryland Mining Co.,	7·304	8·572	400·714	2805·00	57·850	13·61	384	"	"	11·86	22·00	40	34·0	295
Maryland Mining Company, Mean of three trials,	7·204	8·443	423·500	7623·00	58·388	14·28	1051	"	"	11·67	22·95	40	37·5	295
Dauphin and Susquch. Coal Co. Rattling Run, Mean of three trials,	7·597	8·903	523·859	8381·75	68·812	16·17	1101	"	"	12·40	24·00	40	36·6	295

The boiler in which the above Coals were tried was thoroughly cleaned out before commencing an experiment with either of said Coals.

(Signed,) JAMES THOMPSON,
" NATHAN THOMPSON, Jr.

12*

Report of A. L. ROUMFORT, *Superintendent Columbia and Philadelphia R. R., on the Experiments made with the Coal Burner, "Henry A. Muhlenberg."*

SUPERINTENDENT'S OFFICE, *Parkesburg, Nov.* 27, 1850.

To the Honorable, the Board of Canal Commissioners, Harrisburg, Pa.:

GENTLEMEN:—The undersigned, Superintendent of Motive Power on the Columbia and Philadelphia Railroad, having been instructed by your Board to test, practically, the Patent Movable Fire Box, for burning Anthracite Coal in Locomotive Engines, invented by John J. DeHaven, respectfully reports:

That on taking charge of the Road, on the first of September last, he found the locomotive "Henry A. Muhlenberg," refitted for testing this experiment, which was done, as he was informed, by your order, under the superintendence of his predecessor, Colonel Wm. English. The improvement purported to consist: first, in the substitution of Anthracite or Bituminous Coal, as a fuel, for wood, in generating steam; thereby saving from 30 to 50 per cent. in the cost for fuel to the State. And secondly, in constructing a detached and movable Fire Box, entirely separate from the Engine and Boiler; and in such a manner, by the use of flanches, bolts, and connecting pipes, as to attach it to a Boiler, and detach it when necessary for repairs, in a space of time not exceeding twenty-four hours. This latter, (which is the particular improvement covered by DeHaven's patents,) was designed to remove the great objection to the use of Coal Burners, in generating steam, both in Locomotives and Marine Boilers: viz. the *loss of time* necessarily incurred in the frequent repairs of the fire box.

It has been satisfactorily ascertained, long since, that in this section of the country, where wood as a fuel is more costly than coal, and becoming more so annually, that the use of coal in the generation of steam, would be a large item of economy. And accordingly, within the last ten years, experiments made on our principal Railroad and Steam Navigation Lines, have proved to a demonstration, that coal can be used for the purpose of generating steam, in such a way as to be entirely satisfactory, and with a saving of from 30 to 50 per cent., according to the relative value of wood and coal.

The obstacle, however, in the way of its general introduction, has been found to consist in the *fact*, that the heat produced by coal, being more intense in the fire box than that of wood, this intense heat, together with the chemical action of the coal upon the lining of the fire box, destroyed it, in a comparatively short period of time; and that although the great saving in the first cost of fuel, made the actual *cost* of the repairs of the fire box, no object; yet, the *loss of time* occasioned by those frequent repairs was, and still is, a serious evil. For instance: a coal burner in full active duty, may burn out her box in from 6 to 18 months, according to her capacity and service. It would cost from $500 to $1000 to repair her. This cost, however, is much more than made up by the difference of the cost of coal and wood; but the *time* consumed in making this repair, would involve a loss of from four to six weeks on a locomotive, when the engine required no other repairs.

DeHaven's Movable Box is so constructed, that each locomotive or marine boiler, may have duplicate fire boxes, so that when the one in use is burnt out, or becomes injured in any way, it can be removed, and the duplicate put in its place, in a period of twenty-four hours.

In constructing a new locomotive, the cost would not be greater with this improvement than without it. The expense of altering a locomotive, so as to adapt this movable fire box to it, would be from $500 to $1000, according to the capacity of the boiler, including the cost of the box itself.

To test the qualities of the Coal Burner "Henry A. Muhlenberg," she was put in service on the 17th of October last, and has continued to run without intermission up to the present time, during which period she made thirty-four trips between the head of the Schuylkill Inclined Plane and Columbia, a distance of seventy-six miles. This locomotive, when in good repair, burning wood, could draw over the road twenty-one loaded cars. averaging from ten to twelve miles an hour. She has satisfactorily proved, during her recent trial, that she can run from ten to twelve miles per hour, and draw upwards of twenty-one loaded cars, burning anthracite coal.

To do this work, burning wood, requires at least two cords: burning coal, one ton and a half. During the whole experiment of thirty-four trips, the fire box, which is attached to the frame and boiler, has remained perfectly firm and works as well as if it were stationary, and no inconvenience having arisen in these experiments on account of the box being movable, I can see no objection to its use. From my observation and experience, I believe that this fire box, with an adequate force, might be removed, and a ready made duplicate substituted in twenty-four hours, so as to detain the locomotive for this purpose no longer than that length of time.

The result of this test is, therefore, entirely satisfactory to me, and I recommend the whole matter to the future consideration of your Board.

A. L. Roumfort,
Superintendent Columbia and Philadelphia R. R.

December 20th, 1850.—Approved by the Board,
Morris Longstreth, President.

For the Journal of the Franklin Institute.

Steam Propellers between Philadelphia and Liverpool.

During the past month the "City of Glasgow" has made her appearance at our wharves, being the first steamship to this port from Europe, and the pioneer of the new line, which is to consist of the following ships:—"City of Glasgow," (iron,) about 1500 tons, with two engines, 66 inch cylinders, 5 feet stroke, geared to the propeller, which is 13 feet diameter, making two revolutions to the engines' one; "City of Philadelphia," now building in Scotland, to be similar to the "Glasgow."

The third ship is building in New York, of wood, machinery by the West Point Foundry, and consists of two vertical trunk engines; diameter of cylinders 85½ inches, and of trunks 39 inches, leaving an effective

area of 4546 inches; stroke 4 feet 3 inches. They are connected direct to the propeller shaft, and intended to make 34 revolutions, with 15 lbs. of steam, cutting off at half stroke. Diameter of propeller, 16 feet, with three blades made of iron, and weighs about 20,000 lbs.

The fourth ship is to be built here, and is to be of the same size and power as the third.

For the Journal of the Franklin Institute.

Steam Log of the Steamer British Queen.

The following is a copy of the steam log of the steamer "British Queen," when plying between Portsmouth, England, and New York, November, 1839.

Table showing the average working of the "British Queen" steamship, from the time of her leaving Portsmouth until her arrival at New York, in November, 1839.

November.	Press. of steam per square inch, in lbs.	Exp. valve, showing at what part of the stroke the cut off took place.	Degree of vacuum on the condensed side of piston, in inches.	Revolutions of engine per minute.	Speed of ship in knots, per hour.	Consumption of Coals per hour.	Consumption of Coals per day.
						Cwt. qrs.	Tons. cwt
4	4·7	2·8 cut off.	29½	10·40	7·6	23 3	28 5
5	4·9	2·8 " "	29½	9·50	6·4	25 0	30 0
6	4·6	2·8 " "	29½	11·70	8·4	26 0	31 4
7	4·9	2·8 " "	29½	11·30	8·4	24 0	28 16
8	4·8	2·8 " "	29½	10·80	7·6	24 0	28 16
9	5·0	2·8 " "	29½	12·30	9·4	28 0	33 12
10	4·8	2·8 " "	29½	12·50	8·0	25 2	20 12
11	4·8	2·8	29½	11·00	7·2	26 0	31 4
12	4·8	3·8 A. M.	29½	11·00	7·6	27 0	32 8
13	4·9	2·8	00	9·00	5·4	19 2	23 8
14	4·7	2·8	00	8·00	4·4	18 0	21 12
15	4·6	2·8	00	8·80	5·4	19 0	22 16
16	4·8	2·8	29½	12·00	7·6	27 0	32 8
17	4·9	2·8 11 to 12	29½	12·00	9·0	27 0	32 8
18	4·5	4·8 10 to 12.	29½	12·80	9·2	27 2	33 0
19	4·8	4·8	29½	12·00	9·0	27 2	33 0
20	3·3	3·8	29½	13·00	9·2	28 0	33 12
21	4·6	3·8 12 to 1.	29½	12·50	7·4	27 1	32 14
22	4·7	3·8	29½	14·30	8·4	31 2	37 16
23	4·8	5·8	29½	15·01	10·2	33 0	38 12
		Consumption from noon till arrival at New York,					16
		" between London and Portsmouth,					70
		Total consumption				tons,	702

This ship was fitted with Hall's surface condenser, that furnished fresh water to the boilers. It will be observed that the vacuum is remarkably good, and very steady, much more so than in a jet condenser, which may be accounted for by the water being evaporated and condensed

parts, with the atmospheric air mixed with it; also, by not taking in air with the water used for condensation, as in the jet condenser.

The consumption of fuel, it will be seen, is between 30 and 31 tons per 24 hours. This is very moderate, (and may be attributed to the fresh water in the boilers,) when the size of the engines and ship are considered, which were as follows:—Length of keel, 225 feet; between perpendiculars, 245 feet; beam, 40 feet; depth, 27½ feet.

Two side lever engines, cylinders 77½ in. diameter; stroke 7 feet; custom house tonnage, 1862.

The operation of Hall's condenser in this and other ships has demonstrated the practicability of condensing steam sufficiently rapid by exposing it to a cooling metallic surface.

This kind of condenser has been pretty much laid aside, in consequence of two principal objections.

One is, that it is extremely difficult to keep it tight, especially the tubes where they are attached to the tube plate. The pressure of the atmosphere being on the external surface, acts to force the water surrounding into the interior, and mixing with the fresh water.

The other is, that if any derangement occurs to prevent its operation, the engine is useless in consequence. If these defects were removed, the greatest benefit would be derived from the use of fresh water in the boilers of sea steamers.

The following are the times of some of the passages made by the "British Queen," when plying between New York and Portsmouth, England:

Sailed from London and Portsmouth for New York, May 2d, 1840, arrived May 15th—time, 13 days 11 hours.

March 2d, 1839, arrived on 17th—time, 14 days 21 hours.

Sailed from New York for Portsmouth, England, August 1st, 1839, arrived on 14th—time, 12 days 19 hours; from pilot at New York, to pilot at Portsmouth, England, 13½ days. W. S.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, January 16, 1851.

S. V. Merrick, President, in the chair.

Thomas Fletcher, Vice President.

Isaac B. Garrigues, Recording Secretary.

John F. Frazer, Treasurer.

The minutes of the last meeting were read and approved.

Donations were received from Hon. Joseph R. Chandler, U. S. Congress; The American Institute, City of New York; Messrs. Charles E. Smith and Solomon W. Roberts, Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of December; also his annual statement and the annual report of the transactions for the Journal of the Institute, were read.

The Board of Managers and the Standing Committees reported their minutes.

Candidates for membership in the Institute (4) were proposed, and those proposed at the last meeting (7) were elected members of the Institute.

The Committee on Exhibitions handed to the President the gold medals awarded at the meeting in November, which were delivered to such of the parties to whom they were awarded, as were present.

The Tellers of the annual election for Officers, Managers and Auditors for the ensuing year, reported the result, when the President declared the following gentlemen as duly elected:

Samuel V. Merrick, President.
John Agnew, } Vice Presidents.
Abraham Miller, }
Isaac B. Garrigues, Recording Secretary.
Solomon W. Roberts, Corresponding Secretary.
John F. Frazer, Treasurer.

MANAGERS.

Frederick Fraley,
John Wiegand,
John C. Cresson,
Ambrose W. Thompson,
Thomas U. Walter,
Edwin Greble,
David S. Brown,
Owen Evans,
Alan Wood,
William E. Morris,
James P. Ellis,
Henry P. M. Birkinbine,
Henry H. Kelley,
John C. Copper,
George W. Conarroe,
John Thornley,
Robert Lindsay,
Thomas J. Weygandt,
George W. Farr,
Peleg B. Savery,
George P. Herse,
Eliashib Tracy,
George P. Whitaker,
Joseph I. Barras.

AUDITORS.

Algernon S. Roberts,
Samuel Mason,
Uriah Hunt.

Mr. G. W. Smith, Chairman of the Committee, brought before the meeting a specimen of bitumen from Pictou, N. S., where it is found in considerable quantities, and nearly pure.

Mr. Isaac Lea called the attention of the Institute to some specimens of semi-bituminous and transition coal, from Dauphin, on the Susquehanna, 8 miles above Harrisburg, and made the following remarks:

The Dauphin and Susquehanna Coal Company's land included that portion of the west end of the first, or southern coal field, which was semi-bituminous, and that it was the nearest coal to *tide water* in Pennsylvania, being 90 miles to Havre de Grace.

The map exhibited of the several coal fields was made by R. C. Taylor, who, as geologist and mine engineer, explored this coal district, and reported most favorably on it. By it, it may be seen that the southern line of granite arrests the tide water, and thus forms shipping ports at Georgetown, Baltimore, Havre de Grace, Philadelphia, and Trenton. The parallelism to these ports, of the three coal fields—the southern, middle, and northern, or Wilkesbarre—showed the general direction of the stratification of the various formations—running nearly east and west—from the primary rocks to the carboniferous series.

The "hardest" anthracite is found at the east end of the southern or Pottsville coal field, near to the Lehigh, at Mauch Chunk, and proceeding westward the same veins or

seams become "softer"—that is to say, they possess more *volatile matter*. The coal at Pottsville is more easily ignited, and burns more rapidly than that at Mauch Chunk. In Pine Grove district, 12 miles west of Pottsville, the coal is "softer" still; and 10 miles further again, in the Pequa Company's land, the coal of the same veins contains still more volatile matter, and burns with a white flame, but does not coke. This is called *transition coal*, and is such as is used for making iron in South Wales, at Merthyr Tydvil. It is there called "*iron-making coal.*" Four miles further west, at Yellow Spring Gap, is found the true *semi-bituminous coal*, which cokes or swells in burning, but does not "bind" or cement. This quality permits the draft of air to pass through and keep the carburetted hydrogen and carbonic oxide gases constantly ignited; hence the absence of smoke. This condition admirably adapts this coal for *steamers* and *locomotives*. All the European steamers use this kind of coal, which is obtained from South Wales, and it is carried to all parts of the world, where steamers ply, for that purpose. Four miles further west, at Rattling Run Gap, the quantity of volatile matter is still greater, and the coal burns quicker. Three miles further again, at the Big Flats, the coal will bind. Here the veins have narrowed down to three feet in thickness.

The coal at the east end of this coal field, at Lehigh, contains about 6 per cent. of volatile matter, while the transition coal of Rausch Gap contains about 11 per cent., and the semi-bituminous coal of Yellow Spring Gap has 14 per cent., and that of Rattling Run 17 per cent.

This gradation is well marked in the specimens presented, and the change in this coal field may be compared to that of South Wales, and Donetz in the south of Russia, where the same condition of things exists—that is, hard anthracite at one end, and bituminous at the other, with the intermediate gradual changes. The analogy of the coals of Dauphin county with the celebrated Welsh coals, may be understood by the following analyses:

Dauphin Coal.	Vol. Matter.	*Welsh Coal.*	Vol. Matter.
Yellow Springs, Kugler vein,	9·80	Aberdeen Blast Furnace,	8·33
" Backbone vein,	14·88	Tredegar coal,	15·20
Rattling Run, Perseverance vein,	15·80	Dowlas Big vein,	15·62
Grey vein,	11·40	Dowlas Big vein, central part,	11·87
Lea vein,	8·96	Mountain vein, Merthyr,	8·48
Grey vein, black part,	9·78	Cwm-dhu pit, "	9·22
Peacock vein,	9·00	Raslas vein, Aberdaire Iron Works,	9·11

Coals may be classified into four divisions—Bituminous, Semi-bituminous, Transition and Anthracite. *Anthracite* burns with a weak blue flame, and does not swell, making an intense but concentrated heat. *Transition coal* burns with a short white flame, and does not swell or coke. *Semi-bituminous coal* burns rapidly, gives out a long white flame, (carburetted hydrogen,) swells much, does not bind, and makes very little smoke. It evaporates more water than any other kind of coal. *Bituminous coal* burns with a white flame, swells, and while coking "binds," or cements, making much smoke.

The Dauphin Coal Company have finished their railroad in the most substantial manner, with H rail, of the best quality, so that it is said to be equal to any 20 miles in the State. The western terminus is at the town of Dauphin, 8 miles above Harrisburg, where the company have a basin and large depôt, constructed to ship, by the Susquehanna State Canal, any reasonable quantity of coal to market. The works were finished late in the autumn, but in time to send over 4000 tons to market, which has been used in part by Collins' line and other steamers. The engineers of Collins' line reported the Dauphin coal to be "pre-eminent for marine purposes over any of the coals submitted for trial, requiring less labor by 75 per cent." than the Cumberland coal, which evaporated in an hour only 423·5 lbs. of water, while the Dauphin coal evaporated in the same time 523·8 lbs.—thus producing nearly 25 per cent. more steam in a given time.

The Dauphin Company's works being now complete, and all their connexions made, they will commence their regular trade with the opening of the Susquehanna Canal, early in March, when their coal will, it is believed, go into general use in locomotives, as well as steamers, successful experiments having been made in the former by Mr. Baldwin, and other experienced engine builders and engineers.

Mr. Laurence Myers presented his new Railroad Car Revolver, and made the following remarks:

This car consists of two wrought iron cylinders, with plain wrought iron heads, with the rim or fellowe of a railroad wheel slipped over each end of the same, and riveted